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WAR MACHINE

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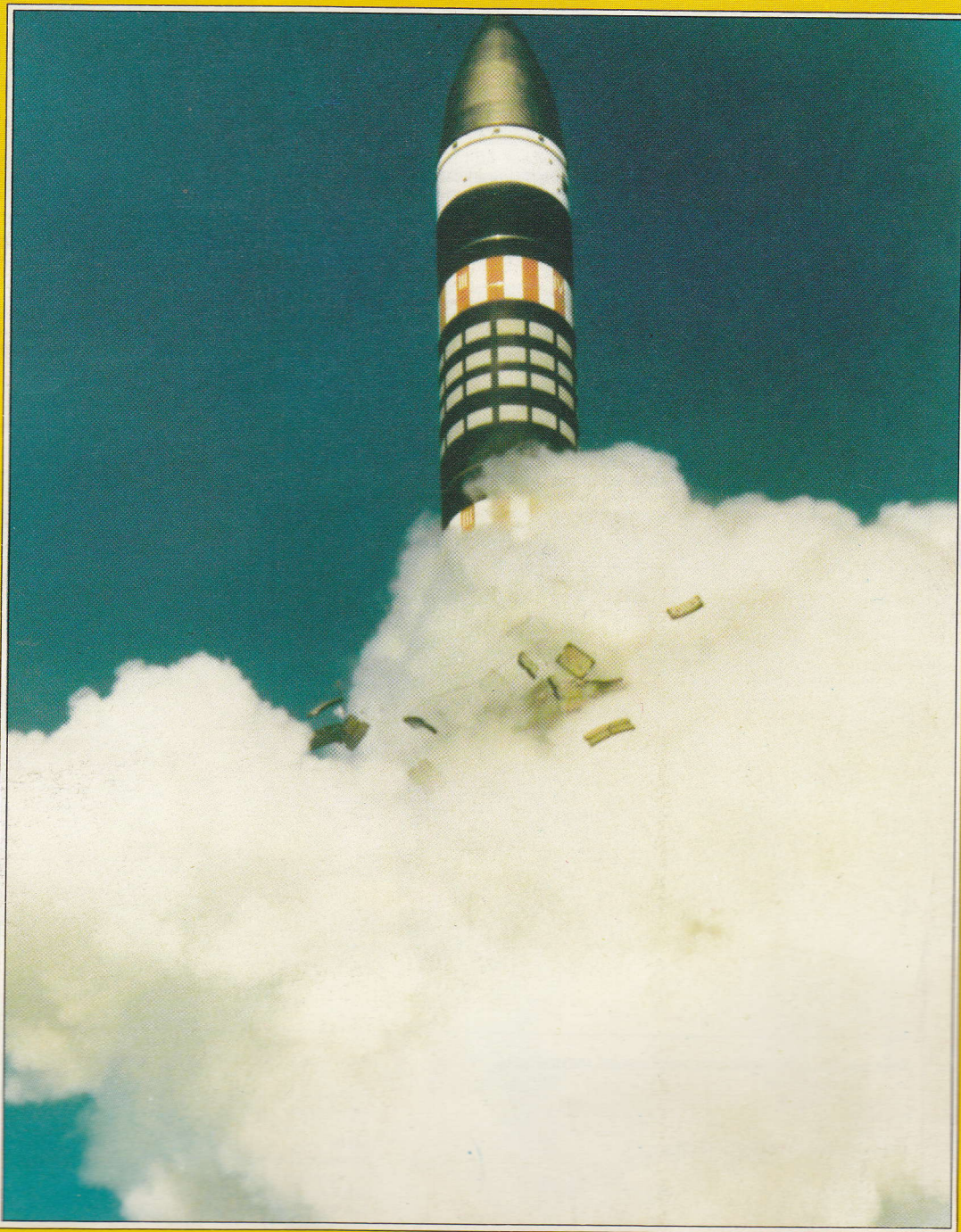
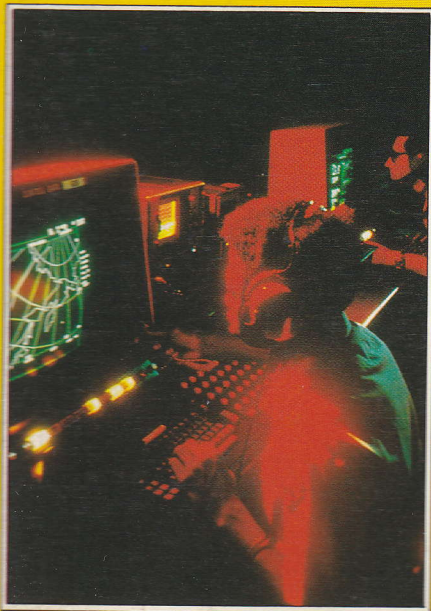
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NORAD:

The 24-Hour
Sentinel

The Militarization
of Space

US Anti-Ballistic
Missile Systems



A fully illustrated guide to Strategic Weapons of the Future

WAR MACHINE

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Editorial Offices

War Machine
Aerospace Publishing Ltd
179 Dalling Road
London W6 0ES

Managing Editor: Stan Morse

Editorial: Trisha Palmer
Chris Bishop
Chris Chant
Ian Drury

Design: Rod Teasdale

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Subscription Manager: Christine Allen
0672-40888

Circulation Manager: Brian Anderson
Marketing Manager: Paul Stelb



Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

Distribution and marketing offices:

Orbis Publishing Ltd
Orbis House
20-22 Bedfordbury
London WC2N 4BT
Telephone: 01-379 6711



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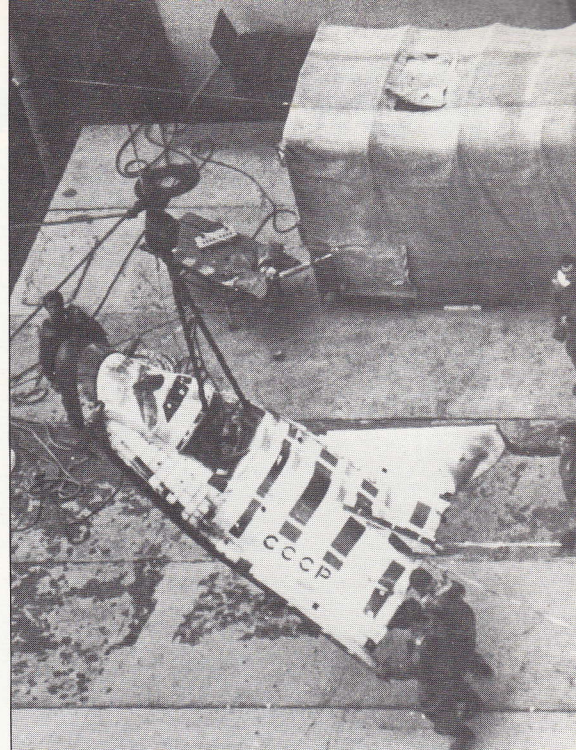
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Strategic Weapons of the Future

The arms race has been with us for many years in one form or another, but the amount of scientific, technological and engineering resource devoted to ever more effective methods of destruction has never been greater than it is today. Weapons are being developed that even 20 years ago would have seemed to be in the realms of science fiction.

Since the early 1980s the number of strategic weapon systems revealed to be either deployed or under development has risen sharply. The USSR has begun deployment of a new generation of mobile ICBMs, cruise missile and strategic bombers, whilst the USA has begun the process of countering these systems by investigating the technology needed for modernizing its own strategic forces. Of these by far the most important and expensive programme is the futuristic Strategic Defense Initiative (SDI) which is designed to provide the research information and prototype hardware required for a ground- and space-based anti-ballistic missile (ABM) layered network to cover the USA and perhaps Europe. The technologies for what is more commonly known as the 'Star Wars' concept includes those associated with high-powered lasers, particle beam weapons and advanced gun types, together with their associated targeting systems. When the US programme is debated, it is often conveniently forgotten that the Soviets are already well into their

The USSR, in spite of claims to the contrary, is whole-hearted in its military space effort. Here a development model of a manned space fighter is recovered.



own 'Star Wars' programme, much of whose technology has already been developed and is in the process of being tested. For instance, by 1981 the highly secret ABM test site at Sary-Shagan near the Sino-Soviet border had tested a massive iodine laser weapon over 30 times against real re-entry vehicles. A similar R&D site for a particle beam weapon was detected near the Soviet town of Semipalatinsk in the mid-1970s, and this prototype weapon is currently involved in open-air testing against airborne targets.

In the light of this, the other nuclear powers are embarking on their own nuclear force upgrading programmes so that they can at least maintain credible deterrents for the years ahead.

Typical of the enhancement which has come to many weapon systems over the last decades, the Pershing battlefield support missile has been developed into a weapon of remarkable accuracy, capable of destroying hard targets of military importance far beyond the edge of the battlefield.



NORAD: The 24-Hour Sentinel

The North American Aerospace Defense Command is tasked with the protection of the United States and Canada from attack by air. As originally envisaged, high-level subsonic bombers were the perceived threat, but the quantum leap in missile technology has demanded a very different capability.

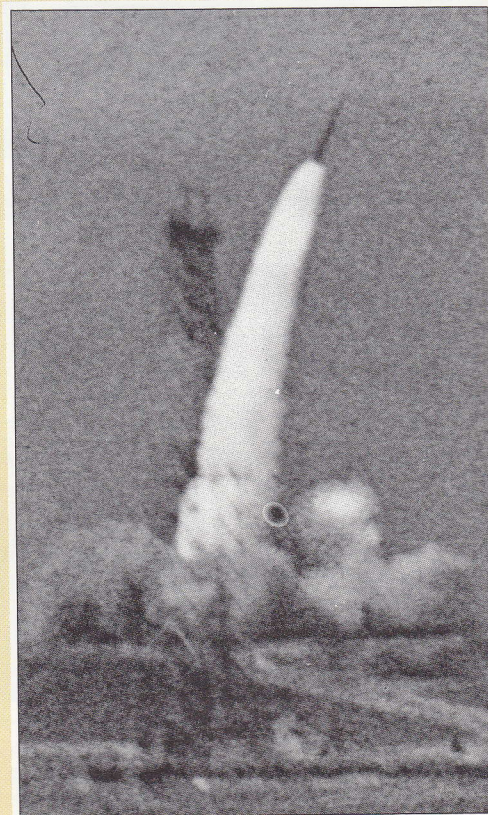
Currently undergoing a major upgrading, the North American Aerospace Defense Command (NORAD) was created in 1957 to defend the continental USA and Canada against the threat of Soviet strategic bombers armed with free-fall nuclear bombs. During the 1970s much of NORAD's equipment was allowed to become obsolete and the rationale for NORAD's existence to become reduced in priority as the Pentagon saw little point in defending against a primary threat which had switched from one of aircraft to one of the ballistic missile. By June 1980, when the infamous double false missile launch alert occurred, it was found by investigators that the lack of resources had carried over into NORAD's missile warning role. Tasked not only with detecting a missile attack on the USA, NORAD's heavily armoured command and control complex at Cheyenne Mountain must also provide the US National Command Authorities (NCA) with data on the numbers, origin and probable targetting of the incoming warheads in order that the NCA can select the appropriate counterattack option from the Single Integrated Operational Plan (SIOP) of enemy targets to be hit.

Specifically, the investigators found that by mid-1985 NORAD had only a limited capability to perform these tasks. The supercomputers used to evaluate the raw radar and satellite information could not cope with the ever-increasing warning, tracking and threat assessment demands placed on them by the increasing Soviet use of MIRVs, decoys and chaff penetration aids. Moreover, the geosynchronous-orbit early warning satellites of the 1960s and 1970s were now vulnerable to enemy electronic jamming and ASAT (anti-satellite) weaponry, although their slow replacement by new jam-resistant and nuclear hardened satel-

lites did provide a patchy upgrading. Many of the ground-based radars, however, were also technologically backward, especially those forming the line stretching along the arctic circle from Alaska eastward to Greenland, Iceland and Scotland (the Distant Early Warning, or DEW, line, which was originally intended to detect over-the-pole attacks by Soviet bombers). With the advent of new terrain-following radars for aircraft and missiles the DEW line had become vulnerable to low-level strikes flying beneath the radars' coverage.

The catalyst for the revival of NORAD in the 1980s have been threefold in nature. They are President Reagan's strategic modernization programme, the Strategic Defense Initiative (SDI), and the new Soviet capability for low-level bomber and cruise missile attack. Although the SDI is aimed at developing a sophisticated layered defence against Soviet ICBM and SLBM attack, it will not detect or destroy the low-level Soviet bombers or cruise missiles, which still remain the responsibility of NORAD itself.

As a consequence virtually every NORAD command, control, communications and warning network is the centre of a major modernization programme. A total of 340 or so manned interceptor aircraft located at 29 alert bases in the USA, Canada and Alaska are being upgraded as fast as possible. By late 1986 the force will comprise some 18 squadrons (five with the McDonnell Douglas F-15 Eagle, two with the McDonnell Douglas CF-18 Hornet, four with the Convair F-106 Delta Dart and seven with the McDonnell Douglas F-4 Phantom) though the two latter types are to be replaced by General Dynamics F-16 Fighting Falcons or successor aircraft by the early 1990s. If required in a crisis, additional aircraft



One of the responses to an incoming missile attack was to have been the use of ground based interceptor missiles of phenomenal performance, such as the point defence Sprint system, one of the components of the abortive Sentinel project.

The Convair (General Dynamics) F-106 remains in service in declining numbers with the US Air National Guard. For many years the mainstay of the US air defence, the F-106 was one of the few aircraft to have been armed with nuclear air-to-air missiles, in the shape of the unguided Genie and the AIM-26A Super Falcon.



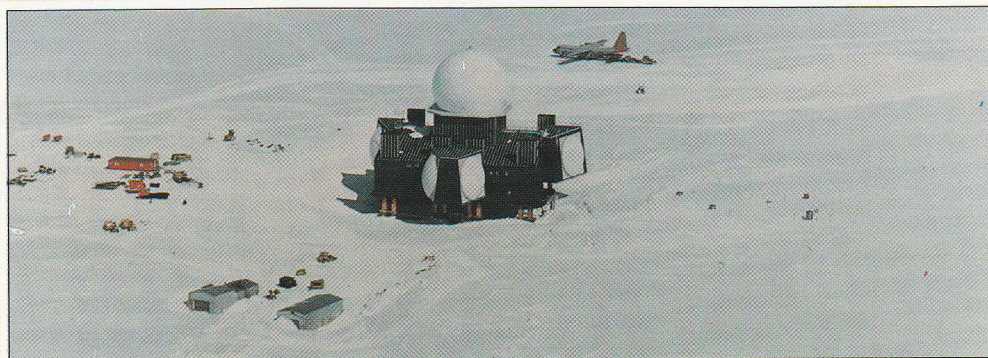


can be drawn from the USAF, US Navy and US Marine Corps assets based in the USA.

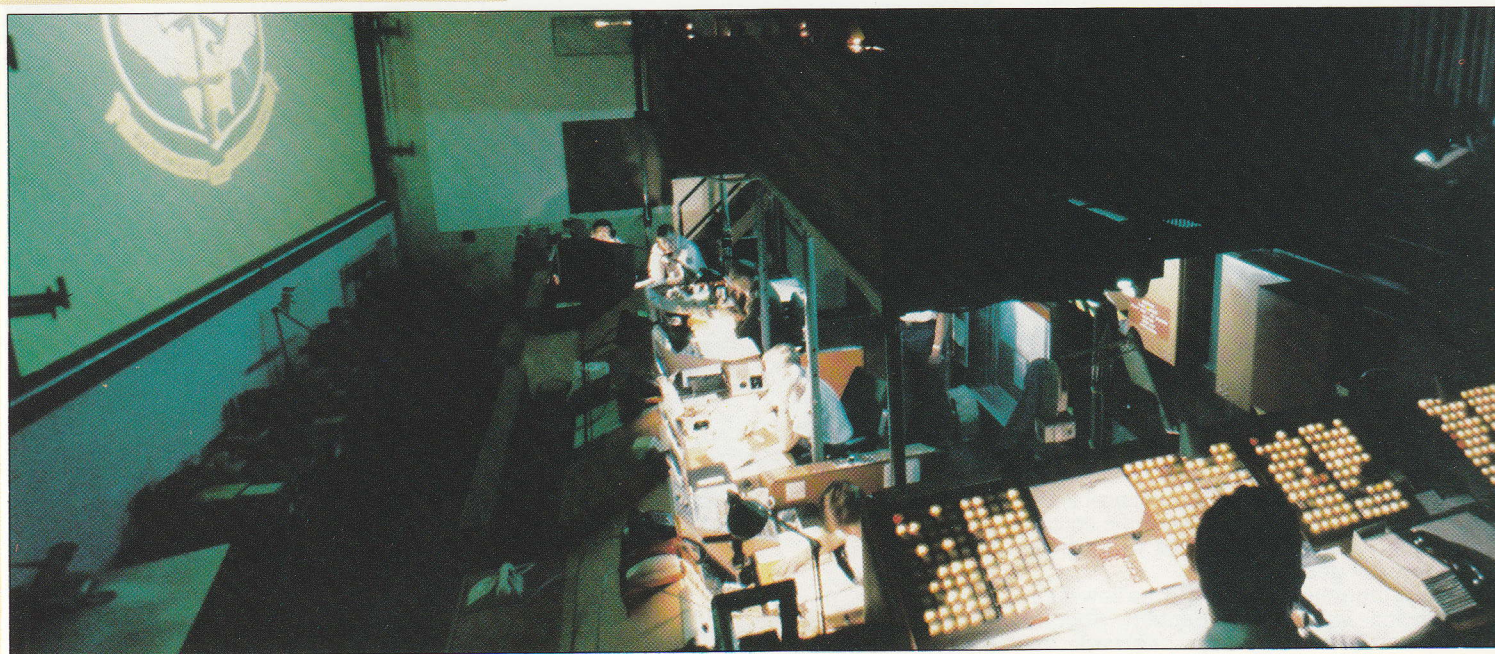
Low-level penetration threat by Soviet bombers and cruise missiles is to be countered by the fielding of up to eight Over The Horizon-Backscatter radar sites to cover the western, eastern and southern coasts, while the arctic circle approaches will be the responsibility of a new DEW line to be called the North Warning System (NWS) which is currently being built with 13 minimally attended 370-km (230-mile) range FPS-117 'Seek Igloo' automated radars (11 of them in Canada) and 39 unmanned short-range 'gap-filler' radars. These systems would be supplemented in wartime by up

Above: The modernization of NORAD has seen the introduction of large numbers of modern fighters to cope with the threat of the new generation of Soviet bombers and long-range cruise missiles. The Canadian Armed Forces have procured the McDonnell Douglas CF-18 as their main air defence aircraft.

Below: The upgrading of North American air defence has seen the original DEW (Distant Early Warning) line thoroughly modernized, with the 1950s and 1960s technology radar stations superseded by automated, computerized (and in some cases unmanned) stations embodying the latest technology.



Below: Heart of the extremely complex range of detection systems, aircraft and missiles that is North American Aerospace Defense Command lies deep within Cheyenne Mountain in Wyoming, where the command and control complex is also situated.





to half of the eight Boeing E-3 Sentry AWACS aircraft currently assigned to NORAD for use with its seven Regional Operations Control Centres (ROCCs) that cover North America as subcommands of the main complex.

Upgraded radar

Abroad, NORAD's Ballistic Missile Early Warning System (BMEWS) radars are also being upgraded with new computer and other electronics to operate in a MIRV warhead environment, whilst at home new 'Pave Paws' SLBM-detection radars are providing improved coverage of the approaches to the USA by replacing older coastal sites. Any SLBMs launched from the lower arctic circle are now the responsibility of the phased-array Perimeter Acquisition Radar Characterization System (PARCS) located near Concrete, North Dakota. This is a legacy of the US Army's cancelled Sentinel/Safeguard ABM system.

The increased military importance of space was also recognized in September 1985 by the creation of the US Space Command at Colorado Springs to work with NORAD. Made up of the USAF Space Command, the US Navy Space Command and the US Army Space Command, the US Space Command has as its main operational responsibilities the day-to-day management of the national space-based missile warning and sensor satellites, the running of any Space Shuttle military missions and the control of the F-15-based ASAT missiles when these are eventually deployed.

Satellite programmes linked to the new command include the Defense Support Program (DSP) Block 647 early warning network, the

Above: In the event of an attack, the command and control functions of NORAD would be enhanced by the transfer north of up to four Boeing E-3 AWACS aircraft, which would be integrated into the new NWS (North Warning System) which is replacing the DEW line.

Below: Each E-3 is much more than an aerial radar station, being equipped to perform all the command and control functions of a ground-based command post. On board, some of the crew would act as fighter controllers, vectoring defending aircraft onto targets.



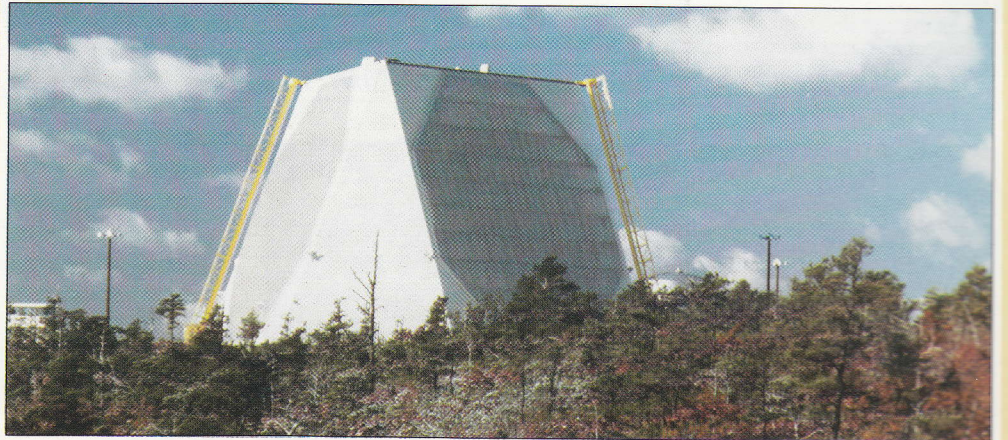
The Ballistic Early Warning system is the heart of US anti-ballistic missile defence, with older radars (now being updated) at Fylingdales, Thule and Clear. Much more advanced detection systems, utilizing phased arrays, are being deployed, such as Cobra Dane (seen here) in Alaska.



new Milstar communications system, the National Command Authorities Defense Satellite Communications System (DSCS) networks, the new generation of Defense Meteorological Satellite Program (DMSP) satellites, and the 18-satellite NAVSTAR Global Positioning Satellite (GPS) network used to carry the Integrated Operational Nuclear Detection System (IONDS) to detect and assess nuclear detonations to terminal users in near-real time. For the future the 'Teal Ruby' satellite-based radar is being developed as the forerunner of a possible space-based radar network to monitor round-the-clock positions of enemy ships and aircraft.

In the longer term it is highly probable that the Space Command and NORAD will be jointly responsible for command, control and targeting of any weaponry developed from the SDI work, but this will not be until some time in the early part of next century.

Right: Pavé Paws is a system of smaller phased array radars designed to detect incoming submarine-launched ballistic missiles. Unlike ICBM attack, SLBMs potentially come in from any direction, so the system must cover the coasts.



Below: The McDonnell Douglas F-15 is the backbone of current NORAD fighter assets, coming into service with Air Force Reserve units as well as in front-line squadrons. These aircraft over the Rockies are from 318th FIS (Fighter Interceptor Squadron) of McChord AFB, Washington State.





USA

MGM-31B Pershing II battlefield support missile system

In 1978 the advanced development programme of the **MGM-31B Pershing II** system was successfully completed. This missile is a modular modernization of the solid-propellant Pershing Ia with considerably enhanced accuracy and range. Achieving initial operational capability in late 1984, a total of 108 launchers have been deployed by the US Army in West Germany as part of the NATO theatre nuclear forces modernization programme. The launchers are centred in a brigade of three battalions, each of which has four firing batteries that are further subdivided into three firing platoons with three mobile launchers apiece. In peacetime one platoon of each battalion is on 'quick reaction alert' at all time, whilst in wartime all the batteries would disperse into the heavily wooded areas where a launcher requires only a 1.83-m (6-ft) diameter clear space above the missile for a successful launch. After a launch the unit would quickly relocate to another area and set up again for the despatch of the next missile. A further training battalion with eight firing platoons is located in the USA.

The Pershing II's RADAG terminal-guidance system depends on an all-weather radar correlation unit in its ceramic nose cone to compare returns from an area (initially of 906 km²/350 sq miles) surrounding the target with a pre-stored onboard radar profile map of the same region. Several such correlations are made during the descent phase to update the RV's inertial guidance system and so generate course corrections to ensure the best CEP value attainable. Values of between 20 and 45 m (66 and 148 ft) have been achieved during the trials phase.

Specification

MGM-31B Pershing II

Dimensions: length 10.50 m (34.45 ft);

diameter 1.00 m (3.28 ft)

Weight: 7439 kg (16,400 lb)

Warhead: 5/50-kiloton selectable yield W85 nuclear

Range: 1399 km (808 miles)

CEP: see text

Launch: wheeled M656 truck and

trailer combination

Guidance: inertial with RADAG terminal homing



Left: A Pershing II launcher is assembled from its travelling configuration. The Pershing force in Germany is centred around the brigade of three battalions; with three launchers per firing platoon, and three platoons in each of the batteries of the battalion, the brigade has a firing strength of 108 launchers.

Above: An early Pershing II is launched from Cape Canaveral. Now fully deployed in West Germany, the highly accurate system poses a considerable threat to Soviet command and control centres far behind the Central Front, being capable of reaching targets deep within the USSR itself.



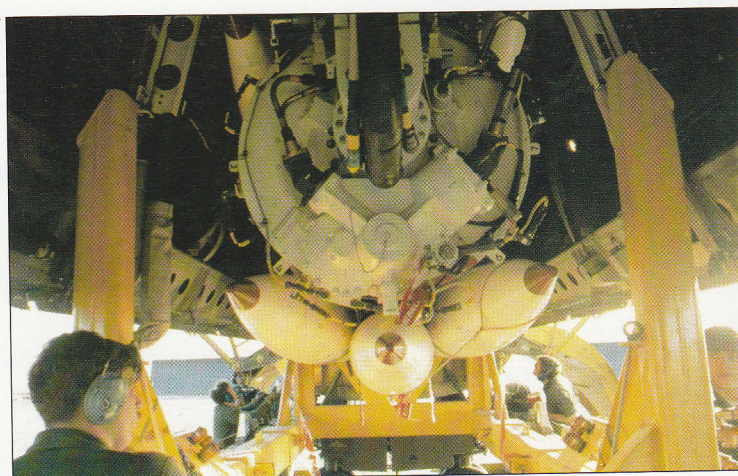
USA

Rockwell B-1B and Northrop Advanced Technology Bomber (ATB)

Resurrected by the Reagan administration (from the cancelled B-1A supersonic strategic bomber project) as part of the strategic forces modernization plan, the variable-geometry **Rockwell B-1B** was chosen in October 1981 for 100-aircraft production run to meet an initial in-service date of 1986. Five 16-aircraft squadrons are being formed with supporting inflight-refuelling tankers at four Strategic Air Command bases to replace elderly Boeing B-52G and B-52H Stratofortresses. The B-1B is able to carry in its three weapons bays varying combinations of nuclear air-to-surface missiles, nuclear free-fall bombs or conventional ordnance and additional fuel tanks. It has an extensive ECM suite (the ALQ-161 system), expendable infra-red and chaff countermeasures, radar warning receiver/location systems and radar absorbent 'stealth' materials which will allow it to penetrate (at low-level and high subsonic speeds) both present and predicted enemy defences until well into the 1990s, and to operate against less

well-defended areas until well into the next century. It will also be capable of the secondary missions of ASW patrol, long-range maritime patrol and aerial minelaying. The airframe itself is made principally of aluminium and titanium alloys and is hardened to withstand nuclear blast and overpressures. The radar cross-section has been reduced to only 10 m² (107.6 sq ft), which compares exceedingly well to the 100 m² (1,076.4 sq ft) of the B-52.

The replacement for the B-1B in the low-level penetration role during the early 1990s is the **Northrop Advanced Technology Bomber (ATB)**, of which very little information has been released. Using a wide variety of 'stealth' technologies the ATB is expected to be smaller than the B-1B, and will have an advanced metal load-bearing structure covered with a radar-absorbing material without flat or sharply angled radar-reflected surfaces. A highly specialized ECM and emission-suppression suite is also under development to reduce to an absolute minimum the



A rotary missile dispenser is loaded up with SRAM nuclear missiles. The B-1B has an astonishing weapons load, capable of carrying 24 of the missiles internally (compared to the Boeing B-52 with a capacity of eight), in addition to the 14 that can be carried externally.

machine's detectability by ESM systems. It is expected that 132 ATBs will eventually be funded under the likely service designation B-2.

Specification

Rockwell B-1B

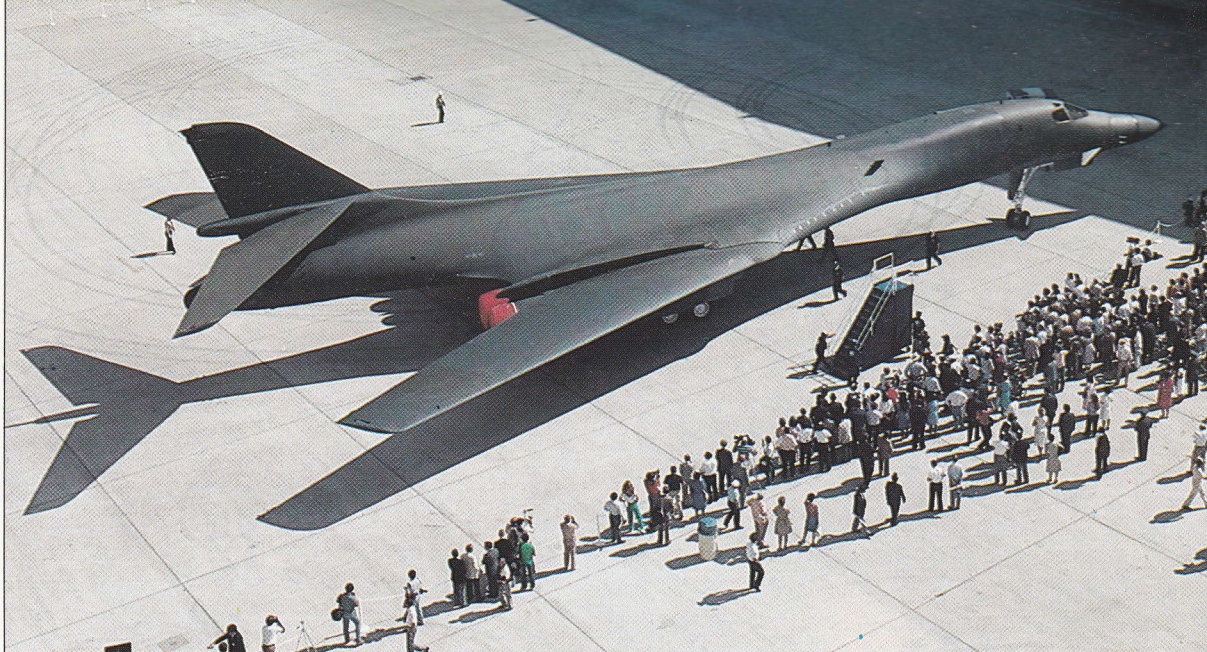
Type: multi-seat strategic bomber
Powerplant: four 13608-kg (30,000-lb) thrust General Electric F101-GE-102 augmented turbofans

Performance: maximum speed (clean) at high level Mach 1.25; low level penetration speed more than 965 km/h (600 mph) at 61 m (200 ft); maximum unrefuelled range approximately 6475 nautical miles (12000 km/7,455 miles)

Weights: empty 78019 kg (172,000 lb); maximum take-off 216367 kg (477,000 lb)

Dimensions: span, spread 41.67 m (136.71 ft) and swept 23.84 m (78.22 ft); length 44.81 m (147.01 ft); height 10.36 m (33.99 ft)

Armament: up to 29030 kg (64,000 lb) of nuclear or conventional weapons



Roll-out of the first B-1B. The contrast with the aged design of the B-52 is considerable, the almost sinuous curves of the more modern machine providing one-tenth the radar cross section of its predecessor.



USA

MGM-118A Peacekeeper heavy ICBM update

The saga of the **MGM-118A Peacekeeper** continues as the US Congress tries as hard as it can to block the deployment of the missile. At present the plan is to base the first 10 (of up to a possible 100 missiles) during 1986 in former Minuteman III silos near the F.E. Warren AFB, Wyoming. The silos will be modernized with updated shock isolation and new command, control and communications facilities, but not hardened further. The solid-propellant Peacekeeper is needed to replace the obsolete Titan II heavy ICBM force which is currently being dismantled, and is meant to threaten all types of Soviet hardened targets such as superhard launch-control centres,

very hard civil and military leadership bunkers and the fourth-generation Soviet ICBM silos.

The payload to be carried is now known to be 10 Mk 21 (formerly ABRV) MIRVs, each of which has a 300-kiloton yield W87 warhead which can, if required, be upgraded to 475-kiloton yield. The warheads can be individually fused for one of five actuation modes depending upon the target type to be engaged: these modes are a high-altitude airburst, a medium-altitude airburst, a low-altitude airburst, a proximity surface burst and a contact surface burst. The dispensing MIRV bus has room for 12 warheads without stacking, but the spare capacity is

used for penetration aids of various types. An automatic retargeting capability allows for the reprogramming of target information to compensate for missiles which are destroyed in their silos by an enemy attack or which malfunction in flight.

Specification

MGM-118A Peacekeeper

Dimensions: length 21.60 m (70.87 ft);

diameter 2.34 m (7.67 ft)

Weight: 87545 kg (193,000 lb)

Warhead: 10 300-kiloton MIRVs

Range: 14001 km (8,700 miles)

CEP: 60 to 90 m (65 to 100 yards)

Launch: silo with cold-launch system

Guidance: inertial



Above: Peacekeeper is cold launched, the missile being popped out of its silo under gas pressure before the first stage ignites. To ensure a tight fit in the silo, the missile is surrounded by a gas seal, which drops away once out of the tube.



Left: MGM-118A Peacekeeper re-entry vehicles pass through a cloud layer over their target at the Kwajalein missile range, more than 4,000 nautical miles from the missile's launch at Vandenberg AFB, California.



USA

US ABM radar system

The main element of the American ABM defence network is provided today by radar systems. The first to be deployed was the **Ballistic Missile Early Warning System (BMEWS)** with three operational sites at Thule, Greenland (FPS-49 and FPS-50 radars), at Clear, Alaska (FPS-50 and FPS-92 radars) and at Fylingdales Moor, England (FPS-49 and FPS-50 radars). Operational since 1962, the BMEWS sites are used in conjunction with two EW (early warning) satellites in the western hemisphere and one in the eastern hemisphere to provide the initial means of detecting ICBM launches. The radars have ranges in the order of 4830 km (3,000 miles).

The launch of SLBMs against the USA will be covered by the new 'Pave Paws' network of four FPS-115 radars which have replaced all but one of the six **System 474N** FSS-7 coastal radar and the ageing FPS-85 radar at Miami, Florida, which is otherwise assigned to the USAF's 'Spacetrack' project. The four phased-array 'Pave Paws' sites are at Otis AFB, Beale AFB, Robins AFB and Schleicher County near Goodfellow AFB, Texas. Additional SLBM coverage to the north is provided by the **Perimeter Acquisition Radar Characterization System (PARCS)** in North Dakota.

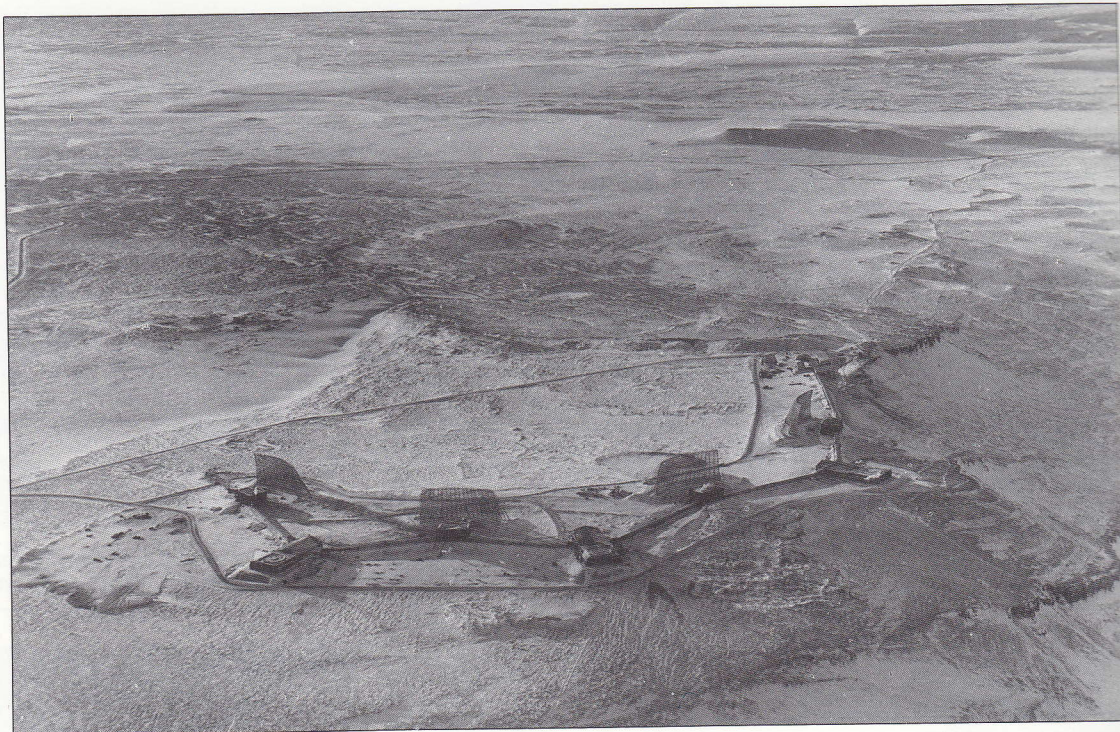
All spaceborne objects are tracked by **System 496L**, operating under the 'Spacetrack' codename and using the FPS-85 at Eglin AFB, the BMEWS radars, FSR-2 passive optical sensors, FPS-17 and FPS-79 tracking radar at Pirinlik, Turkey, and the 'Cobra Dane' and SPQ-11 'Cobra Judy' intelligence-gathering tracking radars at Shemya AFB in the Aleutians and aboard the **USS Observation Island** respectively.

Defence against cruise missile and bomber attack remains the primary responsibility of the **Distant Early Warning (DEW)** line stretching from Alaska to Greenland across the northern reaches of Canada. Now down to 31 FPS-19 and FPS-30 radars (21 in Canada, four in Greenland, two in Iceland and one in Scotland), this network is to be replaced by the **North Warning System (NWS)** with 13 Minimally Attended Radar (MAR) FPS-117 sites and 39 unmanned gap-filler short-range sites. To cover the rest of the approaches to the USA eight **Over the Horizon-Backscatter (OTH-B)** radar are being built to provide an all-altitude coverage at ranges varying from 900 km to 3800 km (560 to 2,360 miles) from American coasts.

Specification 'Cobra Dane'

Type: long-range surveillance radar using a 30-m (98.43-ft) diameter circular planar phased array
Capability: range in the space tracking mode 45865 km (28,500 miles) and able to track 100 targets simultaneously (20 of them followed precisely), in the early warning mode the radar can cover a corridor 8045 km (5,000 miles) by 3220 km (2,000 miles) and able to track 200 targets in near-real time

The AN/FPS long-range phased array radar at Eglin AFB in Florida is the main component in the Spacetrack system, but has also been integrated into the SLBM detection net, which takes up about 20 per cent of the scanner's capacity.



Specification FPS-115

Type: long-range SLBM detection and tracking radar using two 30-m (98.43-ft) circular planar phased arrays

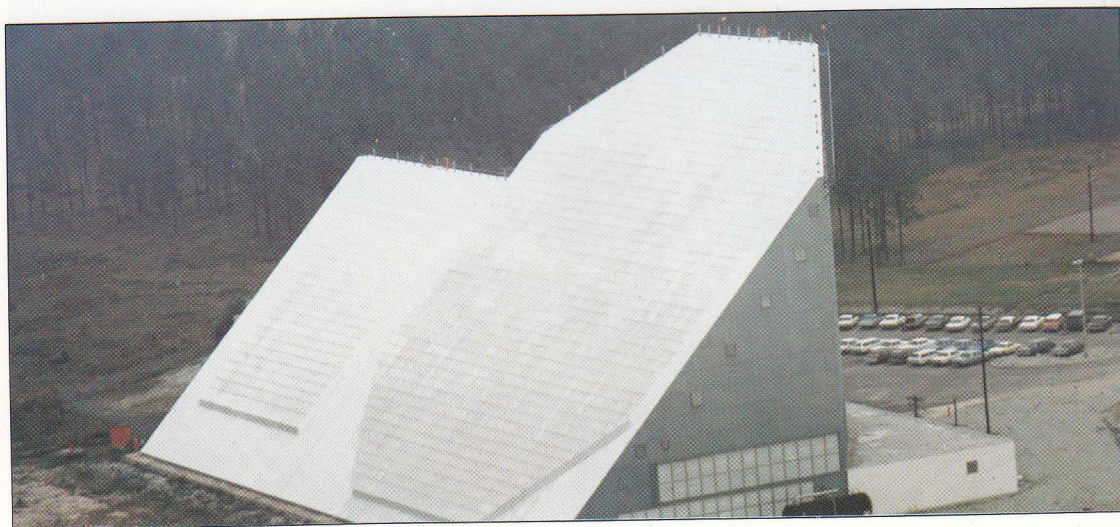
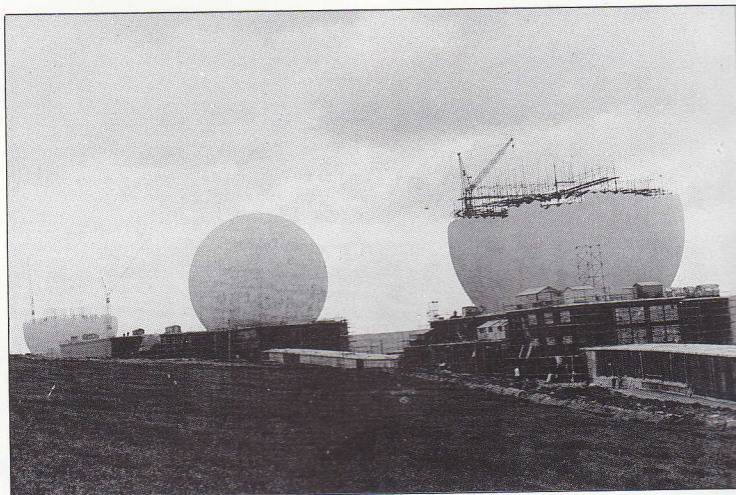
Capability: able to detect and discriminate SLBMs at a range of 3,400 miles (5,470 km), and to provide early warning, launch, position, velocity and impact data on targets

Specification FPS-49

Type: long-range early warning and tracking radar using a 25-m (82-ft) diameter parabolic reflector in a dome
Capability: able to detect multiple targets and to track warheads at a range up to 4830 km (3,000 miles)

Right: The bomber threat was soon overshadowed by the rapid evolution of the ICBM. Fylingdales Moor was one of three ballistic missile warning stations. Now the subject of a major update, the BMEWS stations work in conjunction with a network of EW satellites.

Thule, on the extreme north west coast of Greenland, has been an important radar station since the 1950s. The AN/FPS 50 static radars utilize antennas 122 m (400 ft) wide and 50 m (164 ft) high to scan for targets, in conjunction with the dome-mounted AN/FPS 49 dish-type radars.



The Militarization of Space

One of the most basic principles of military philosophy is to 'take the high ground', giving your troops an advantage over the enemy. To the modern military mind, it has been obvious from the start that space is the new high ground, and to that end military involvement in space research has been considerable.

Below: Following the disaster which overtook the US Space Shuttle programme in the January 1986 Challenger explosion, the subsequent suspension of Shuttle launches has forced the USAF to fall back on the Titan launchers kept in reserve, and to propose modifying surplus Titan ICBMs.

Much has been said recently about the militarization of space by the American 'Star Wars' programme and all it entails. The sad fact remains that despite all this rhetoric such a process actually started the day that the Soviets launched their Sputnik I satellite back in 1957. The respective superpower photo-reconnaissance and Elint satellite networks which evolved from that day now monitor the forces and validate the claims of its rival with almost unnerving accuracy to produce what has in effect become an overall stabilizing influence on world events and on the strategic issues which condition such events.

First priority

In a global war, however, the priority for each side would become the need to destroy these prying eyes as quickly as possible so that military intentions would not be assessed before they could take effect. Thus in the 1960s both the Soviets and the Americans embarked on the development first of suitable ground-based tracking systems to watch the skies for satellite orbits, and then of the means to destroy them. The US armed forces leaned towards the use of what is known as a direct-ascent anti-satellite (ASAT) weapon which is fired under radar guidance straight at a target and then uses a command-detonated nuclear warhead with its prompt radiation and resultant EMP to destroy or disable the satellite.

Two systems were developed to deployment status. The first was based on the US Army's DM-15B series Nike Zeus ABM and codenamed Programme 505. Deployed at the Kwajalein Atoll test site in the Pacific, it employed a new DM-15S series Nike Zeus missile, which carried a high kiloton yield thermonuclear warhead to intercept satellites out to a maximum orbit of around 555 km (345 miles). By late 1963 an installation with one DM-15S always on operational alert had been completed.

However, from mid-1966 Programme 505 was slowly phased out because of the availability of the USAF's direct-ascent ASAT Program 437 at Johnson Island, 1150 km (715 miles) south of Honolulu. This used two LV-2D Thor IRBM conversions on launch pads and each armed with a 1.4-megaton yield W49 thermonuclear warhead with a satellite-killing distance of 8 km (5 miles). Capable of attacking targets out to 1300 km (808 miles) orbital distance and with a horizontal range of some 2780 km (1,725 miles), the Thors remained the sole American ASAT asset until mid-1970, when the programme was reduced to a 30-day stand-by status. The project was finally terminated in 1972 after a hurricane hit the island and devastated the installations.

Soviet ASAT

Two years before the Americans first set up an operational ASAT system in 1966, the Soviets created a special ASAT branch of the PVO-Strany air defence force known as the PKO (Protivo Kosmicheskaya Oborona, or Against Cosmic Attack). By 1966 the Soviets were assessed as having a direct-ascent weapon possibly based on a development ver-





Above: The US Air Force has established Space Launch Complex 6 at Vandenberg AFB in California as the west coast (and main military) launch site for the Space Transportation System (Shuttle). Here the shuttle Enterprise is moved to the launch pad.

sion of the ABM-1A 'Galosh' ABM. The Soviets also paralleled this by developing an orbital ASAT system which was carried by the F-1-r booster version of the SS-9 'Scarp' ICBM and first flown on 27 October 1967. The ASAT tests lasted until 1971 and utilized an initial parking orbit for the powered interceptor and then either a co-orbit or fast fly-by terminal attack profile to destroy the target satellite. The tests then came to a halt and did not resume until February 1976 following a significant advance in China's space programme.

These new trials introduced the third terminal attack profile into the Soviet ASAT programme, which required less than one orbit from launch to target interception. This gave the Soviets a genuine fast-reaction capability to destroy American satellites whilst out of ground-based tracking range and, more importantly, to hit manoeuvring satellites trying to take evasive action. In 1977 the US DoD confirmed that the Soviets had a fully operational ASAT weapon armed with a conventional HE-fragmentation type warhead. At the same time it was recognized that the ASAT weaponry was also directed against the Chinese with their newly acquired photo-reconnaissance capability. As a counter to the Soviet system the Americans went back to their design boards and came up with the Project 1005 Vought Miniature Vehicle ASAT that could be carried and launched by a McDonnell Douglas F-15 Eagle fighter. Tested in the early 1980s after

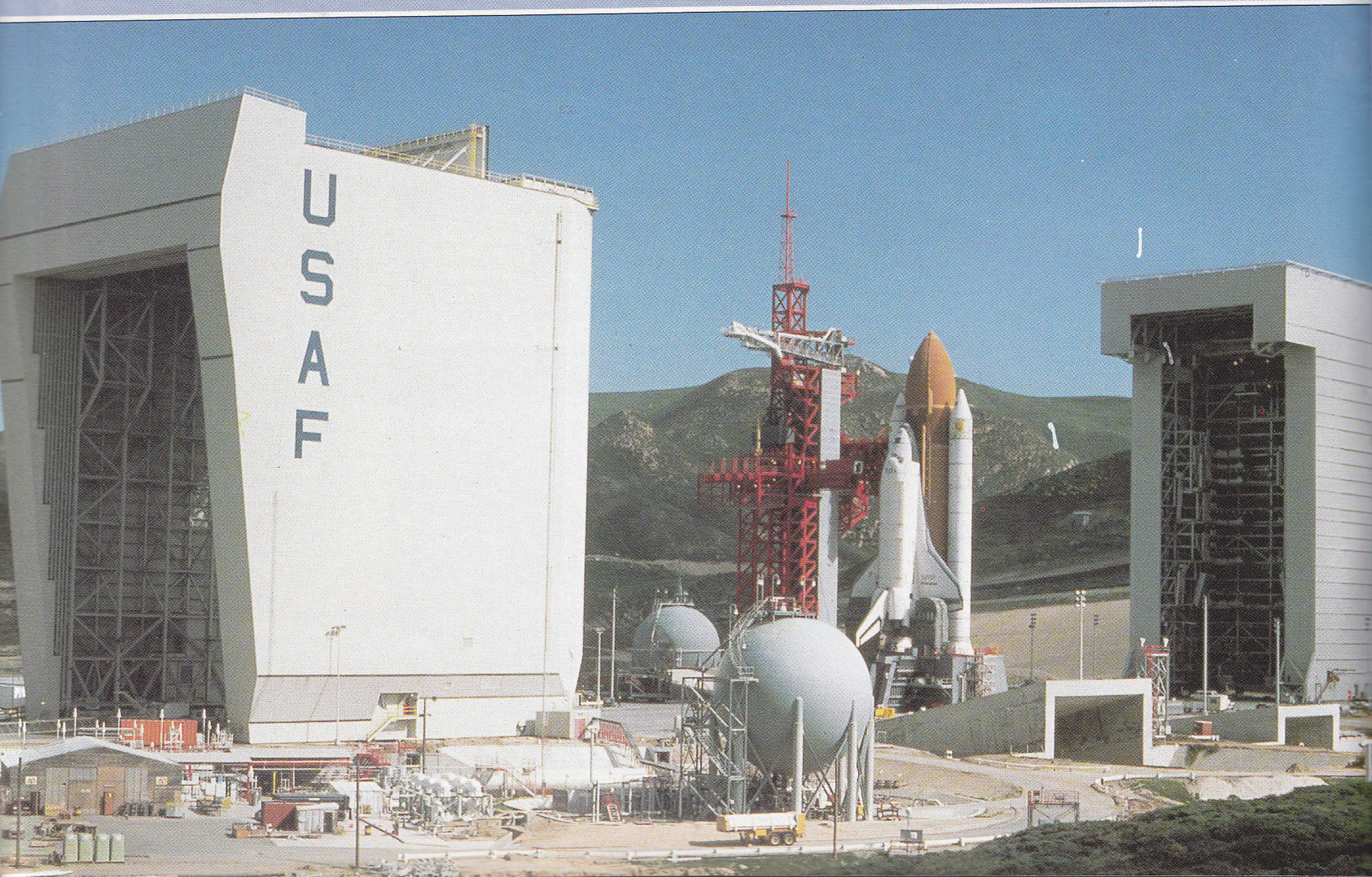
several delays (and given Congressional willingness to deploy it) the Vought ASAT weapon should be available to two squadrons of Eagles based in the USA by the end of the decade and under the command and control of the US Space Command.

By 1980 the Soviets had resumed their own ASAT testing again following a three-year hiatus, flying the first prototype of a new interceptor using an IR guidance system instead of the more normal radar. This weapon demonstrated the capacity for inspecting a target before actually attacking. American intelligence also indicated that the Soviets had brought into service a new direct-ascent ASAT weapon armed with a nuclear warhead and the ability to destroy previously safe high-orbit geosynchronous communication, early warning and Elint satellites.

Manned programmes

Concurrently with the ASAT testing of both sides, the superpowers also began to exploit their manned space programmes for military use. The Soviets developed a specialized military version of their Salyut space station which was flown on several occasions during the flight series, whilst the unmanned Salyut-6/Cosmos 1287 space link up in June 1982 was interpreted by American intelligence agencies as the first testing of a space station defence system armed with small IR-guided interceptor missiles to prevent possible American interference with Soviet satellites or space stations in a war scenario. On the American side the Space Transportation System (STS, more commonly known as the Space Shuttle) was built during the 1970s as a NASA project heavily subsidized by the American military.

Below: SLC-6 at Vandenberg, with the Enterprise on the pad. In spite of the Challenger disaster, too many DoD and NASA eggs are in the shuttle basket to consider cancellation of the programme, although launches have been set back many months.



With one-third of its flights scheduled for military purposes before the January 1986 *Challenger* disaster, and with the special Vandenberg AFB military space port for it just about to be completed, President Reagan also chose the STS for use as the space test bed for much of the technology to be derived from his Strategic Defense Initiative (SDI) plans. Not to be outdone by the Shuttle (and despite the vehement propaganda aimed at its use for military purposes) the Soviets are known to be developing a similar spacecraft plus a smaller manned spaceplane. This is far more important as the latter is known to have several military roles including those of a mobile space station defence fighter and a manned ASAT system. This finally validates the Soviet 1964 definition of the role of the PKO, which stated that it will be equipped with special spacecraft and vehicles controlled either from the ground or by special crews to attack enemy space systems. Coupled with this is the Soviets' own prodigious research and development into the technology envisaged for the American SDI programme.

Advanced technology

The Soviets are known to have an operational particle beam R&D facility at Semipalatinsk using power generated by a small nuclear explosion. They also have a conventional HE-powered iodine pulse laser installation at the ABM test site at Sary-Shagan near the Soviet-Sino border. This latter has now been joined by several air-defence test lasers and an ASAT-capable laser weapon. Yet another laser of the electron beam pumped carbon dioxide gas-dynamic type has been identified at an installation near Moscow for ASAT use, whilst programmes involving research on radio-fre-



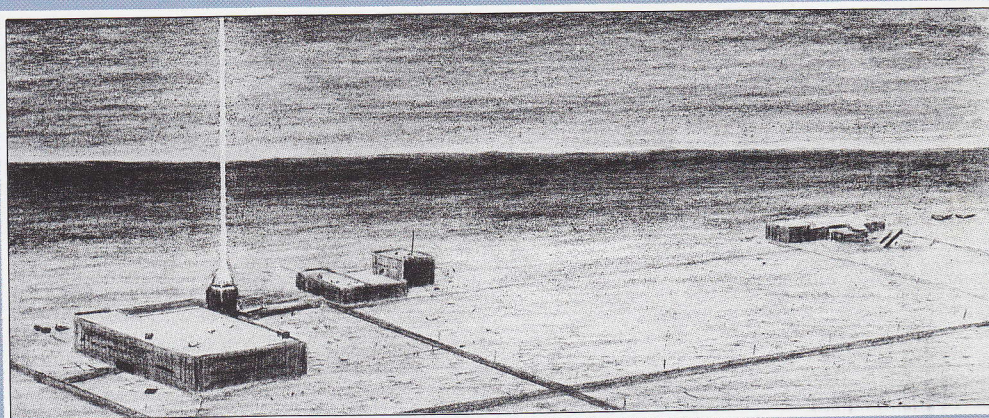
Above: The USSR has had an operational anti-satellite interceptor system based at Tyuratam since 1971. Capable of reaching targets in orbits out to 5000 km (3,100 miles), it destroys other satellites by means of a giant 'shotgun blast' of pellets.

Below: The launch and manning of the new Soviet 'Mir' space station speaks eloquently of the effort made by the USSR in Earth orbit. When the Soviet shuttle equivalent becomes operational, one of its roles will be to service increasingly sophisticated manned space complexes.

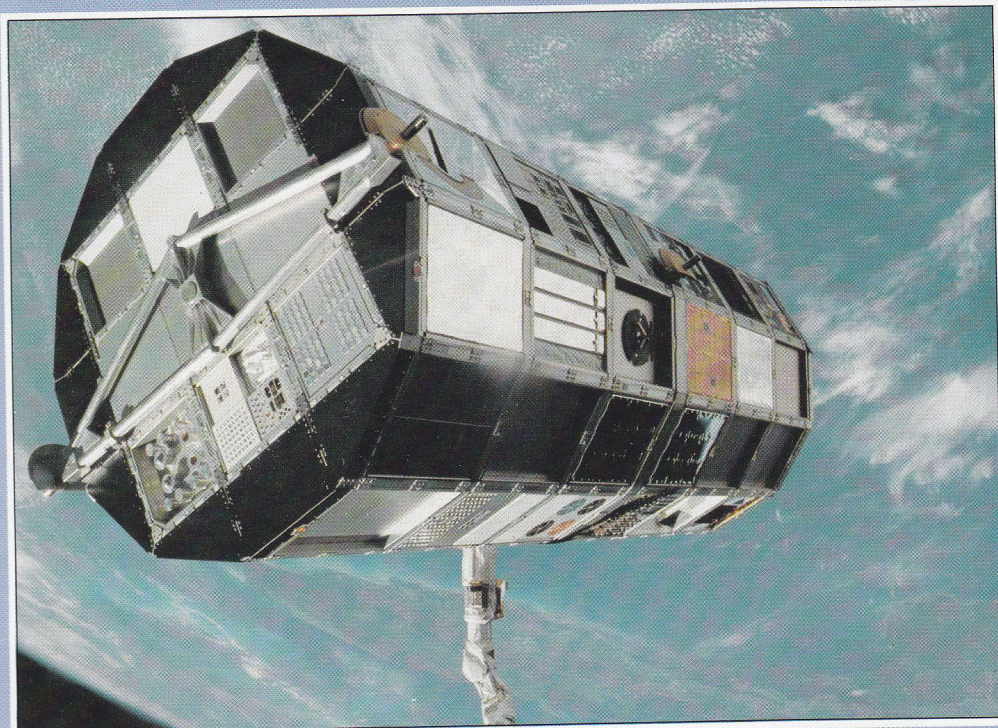


The Militarization of Space

cy signals to interfere with or to destroy electronic components of ICBMs or satellites, and on kinetic-energy weapons using the high-speed collision of small mass with a target have also been identified. By the 1960s the Soviets had already developed an experimental gun assembly that could shoot streams of high-density metals such as tungsten or molybdenum at 25 km (15.5 miles) per second in air and over 60 km (37.3 miles) per second in a vacuum. By the 1990 American intelligence expects that many of the research programmes will have resulted in operational systems both on the ground and on space-based satellites, space stations and spaceplane fighters, whilst the SDI is not expected to result in any deployable systems (if at all) before the turn of the century.

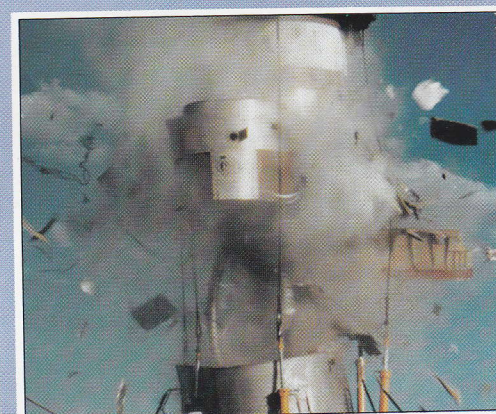


Above: The Sary Shagan proving ground by Lake Balkhash in Kazakhstan is one of the sites where directed energy weapons such as high-powered lasers and particle beams are being developed.

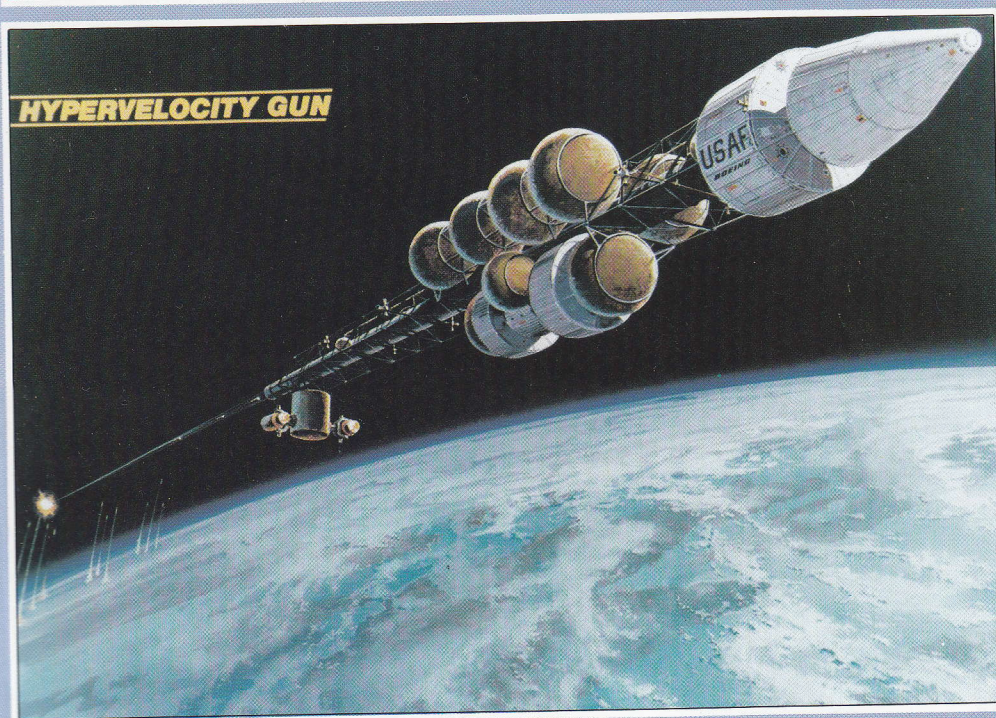


Left: The shuttle deploys a long duration satellite on the end of its remote manipulator arm. Such systems are designed to remain in operation until retrieval by another shuttle mission up to a year later. The shuttle is the only means of doing this and returning it undamaged to earth for analysis.

Below and bottom: Before and after shots of a Titan I booster during the first laser lethality test conducted for the Strategic Defense Initiative. The laser (the most powerful continuous wave system outside the USSR) was the Mid-Infra Red Advanced Chemical Laser (MIRACL), which was in operation for several seconds.



Left: The space-based Hypervelocity Launcher, or Railgun, launches projectiles by means of an electro-magnetic accelerator at velocities of up to 29000 km/h (18,000 mph). Using 'Smart' warheads, targets could be destroyed by kinetic energy alone.



US Anti-Ballistic Missile Systems

At first glance, the task of intercepting ballistic missile warheads in flight would seem to present almost insurmountable problems, given the short warning time and the speed of the target; yet it is a challenge upon which enormous resources have been expended.

The first US attempts at creating an anti-ballistic missile (ABM) programme began in 1954 when both the US Air Force and US Army combined with civilian manufacturers to investigate the possibilities. The USAF teamed with Convair and RCA to develop the Wizard, using concepts such as electronic scanning radars that were really too advanced for the time. Thus the project was cancelled in favour of the US Army's effort with Western Electric and Bell Laboratories, whose Nike Zeus project was showing more promise.

The 640-km (400-mile) range weapon was to be deployed in the defence of US cities and military targets under the control of several different radar types used for target detection, tracking and missile guidance. Unfortunately the mechanically-steered radar (MSR) system had a limited capacity to handle the large number of incoming targets envisaged, whilst the missile itself was sufficiently slow to need launch on initial target detection, with the result that its guidance radars could not take advantage of the natural filtering out by the upper atmosphere of booster debris and penetration aids shielding the actual warheads in their exo-atmospheric approach.

By the early to mid-1960s the US Army's ABM interest had shifted to the Nike X project, which was aimed at developing protection for high-value targets such as command centres and major industrialized cities. New phased-array radars were developed to handle the large numbers of targets, together with a 37-km (23.13-mile) range high-acceleration interceptor missile called the Sprint to overcome the endo-atmospheric limitations of the Nike Zeus. Later a long-range Perimeter Acquisition Radar (PAR) was added to serve the definitive 740-km (460-mile) range Nike X exo-atmospheric missile designated Spartan.

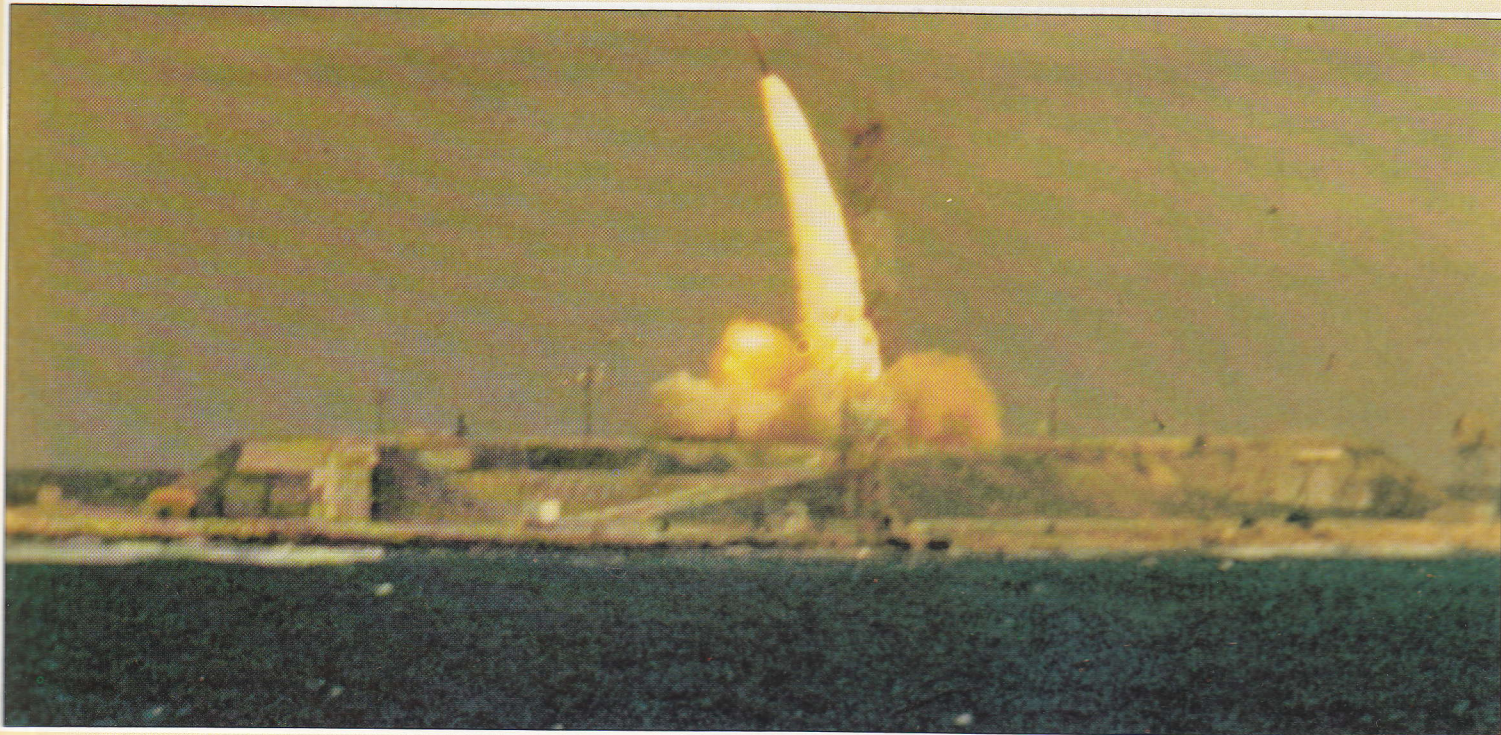
The decision to deploy the whole system, now codenamed Sentinel, was taken in 1967 with the aim more to defend against a possible Chinese ICBM strike or accidental missile launch than to counter the basic Soviet ICBM threat. A total of 25 launch sites (16 with 100 Spartan missiles each and nine with 100 Sprint missiles each) was to be built, together with six PAR and 17 MSR radar installations. However, basing of some of the sites near cities, coupled with limited radar coverage and a vulnerability to a sneak SLBM attack, caused the programme to be scaled down and redirected from defence of population centres to defence of strategic weapon assets such as the Minuteman ICBM fields. Redesignated Safeguard, the new network comprised 12 sites with 360° MSR radar coverage, 360 Spartans equipped with 4-megaton yield W71 thermonuclear warheads and 840 Sprints equipped with 10-kiloton yield W66 enhanced-radiation fission warheads.

The first phase of the plan involved the construction of two ABM sites at Grand Forks AFB, North Dakota, and Malmstrom AFB, Montana. However, in mid-1972 when the SALT-1 ABM treaty was signed between the USSR and the USA, the deployment on both sides was limited to two ABM installations with just 100 missiles at each, one to protect the national capital and one to protect an ICBM field. In July 1974 a further protocol was signed between the two superpowers to limit the deployment to just one site each. The USA chose to complete the Grand Forks ICBM field-defence site and declared it operational in



Below: A Sprint missile is launched from the missile range on Kwajalein atoll in a successful interception of a Polaris boosted target which simulated a Soviet submarine launched missile, requiring interception at very short range.

Above: Spartan was the long-range component of the Sentinel system, being designed to intercept incoming warheads with a large nuclear blast out of atmosphere at altitudes of up to 122000 m (over 400,000 ft).

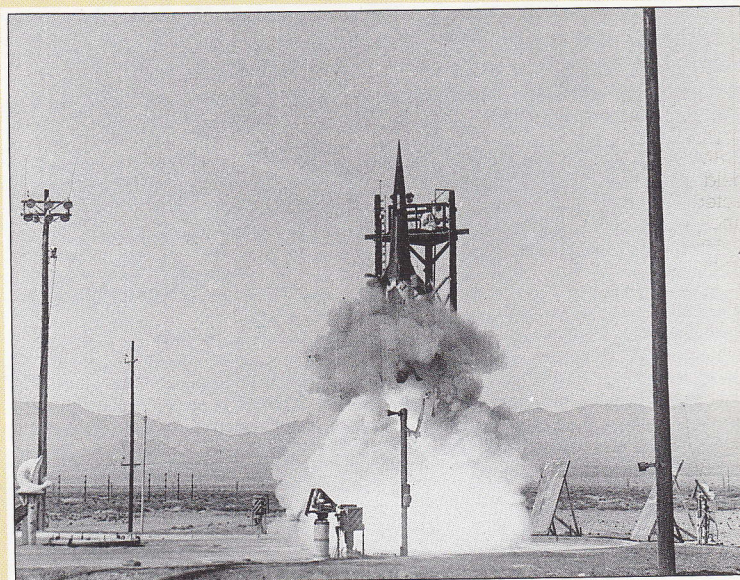


US Anti-Ballistic Missile systems

October 1975, only to close it by special congressional decree on the following day. This strange decision was taken in the light of two facts. The first involved the recognition that the single site was extremely limited in its capabilities against a massive ICBM attack but, more importantly, the second entailed the recognition that explosions of interceptor missiles both within and outside the atmosphere over or near the USA would cause immense damage to the country's own communications and electronic systems because of the electromagnetic pulse (EMP) phenomenon produced during the nuclear detonation of the warheads.

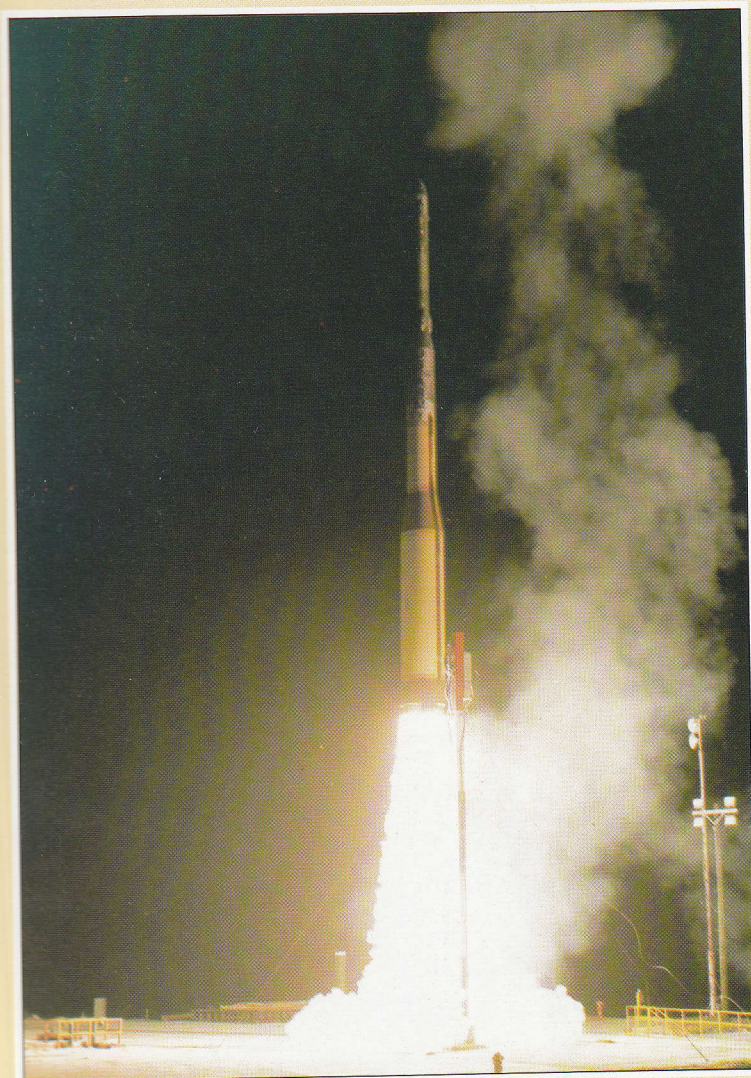
Consequently the emphasis was shifted from nuclear-armed weapons to those of a more conventional type. Although ABM deployment on a large scale was prohibited, research and development could take place on a limited basis. One such missile studied was the single-stage high-speed Sentry armed with a very-low-yield nuclear warhead producing prompt radiation and designed to knock out re-entry vehicles in the terminal phase of their flight. Although not actually deployed, Sentry remains an option as part of a future layered ABM network with non-nuclear interceptors for use outside the atmosphere. The US Army has already tested one such weapon in the Homing Overlay Experiment (HOE), the relevant missile being launched from the Kwajalein Atoll test site in the Pacific. The weapon in space deployed a large metallic canopy, which upon impacting the target re-entry vehicle effectively destroyed it by physical contact. The HOE weapon is also a candidate for use in an anti-satellite (ASAT) model.

Further ABM R&D work is centred on passive defences and the Strategic Defense Initiative (SDI) programme, which is investigating the possible use of exotic land- and space-based weapons such as lasers, particle beams and electromagnetic rail solid-projectile guns.



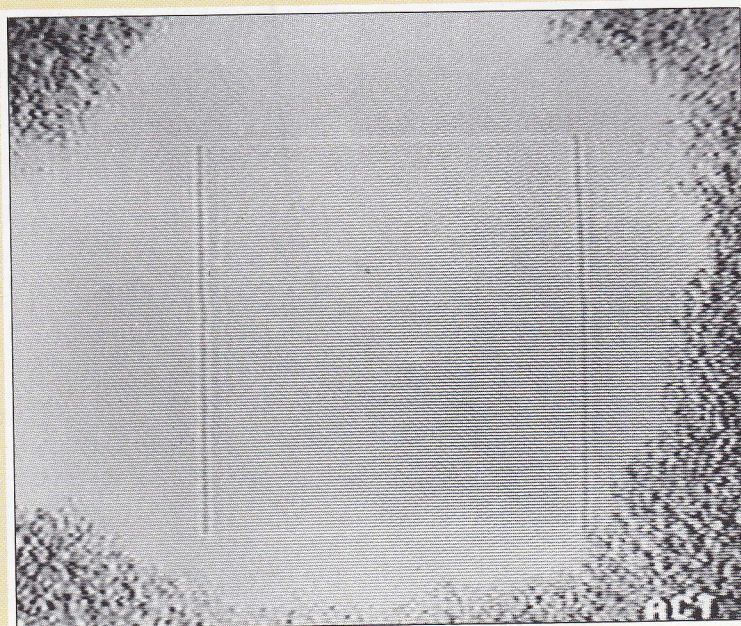
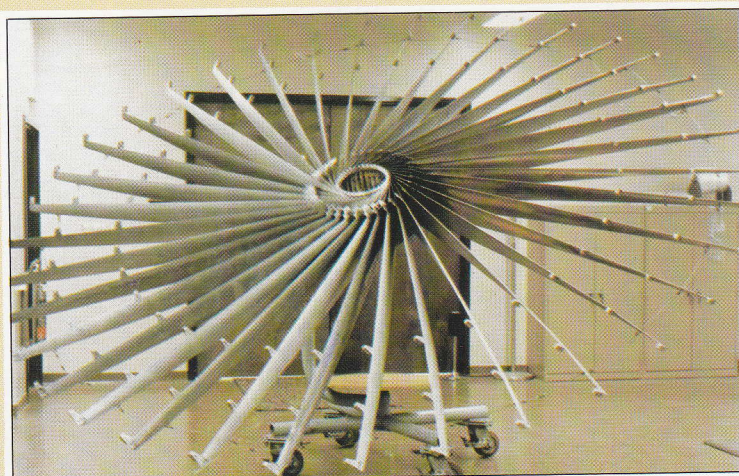
Above: Unlike Spartan, Sprint operates within the atmosphere, enormous acceleration to hypersonic speeds making warhead interceptions down to 30,000 ft (9150 m) feasible, and at ranges up to 37 km (over 23 miles) from launch.

Below: The 'warhead' of the US Army's HOE (Homing Overlay Experiment) which is designed to intercept re-entry vehicles. The 2.1-m (7-ft) metal ribs are wound round the core in flight and unfurl seconds before collision.



Above: The three-stage HOE missile lifts off from Kwajalein in the series of attempts to make a direct impact intercept of an ICBM re-entry vehicle. The series of flights succeeded in its aim, with the fourth launch, seen here, making an interception more than 160 km (100 miles) above the Pacific.

Right: This photo is from the video film of the successful HOE interception taken through a 61-cm (24-in) telescope on Kwajalein. The frame shows the debris a tenth of a second after the homing third stage of the missile smashed directly into an inert ICBM re-entry vehicle.





USA

Small Lightweight ICBM programme

The inability of Strategic Air Command to find an acceptable long-term basing mode for the MGM-118 Peacekeeper ICBM resulted in the engineering study of a possible alternative in the form of a small highly dispersible lightweight land-based ICBM with a single 300/500-kiloton yield warhead that would have a projected CEP of between one and two times that of its larger brother. At least three different possibilities have been studied to date. The first, known as the **Midgetman**, was around 15.24 m (50 ft) long, had a launch weight of 9072 to 13608 kg (20,000 to 30,000 lb) and a range of 11265 km (7,000 miles). Between 3,000 and 4,000 missiles were projected as being deployed in small blast-resistant silos spaced about 1.6 km (1 mile) apart over an area of some 11660 km² (4,500 sq miles). The major problems discovered for such a system were, however, the high cost and potential difficulties with the guidance system.

The second weapon was Boeing Aerospace's three-stage **Small ICBM (SICBM)**, which was to be about 11.58 m (38.0 ft) long and 1.07 m (3.5 ft) in diameter, weigh some 11340 to 15876 kg (25,000 to 35,000 lb) and have a 453.6-kg (1,000-lb) throw-weight. This version was to be deployed in some 3,350 super-hardened silos about 457 to 610 m (1,500 to 2,000 ft) apart on existing military bases throughout the western USA or at Minuteman mis-

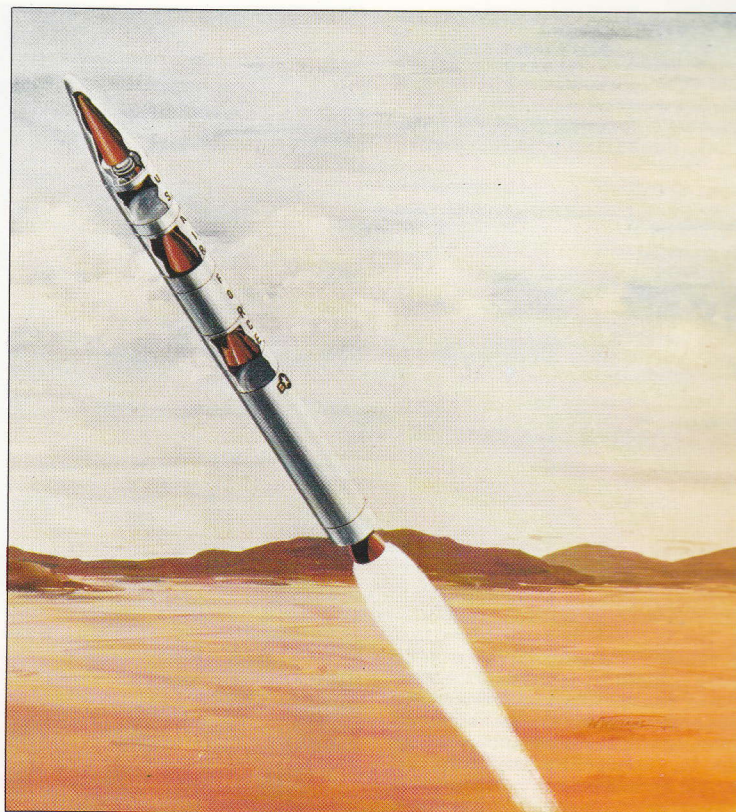
sile fields.

The third system studied was a major modification of the Martin Marietta Pershing II, to be known as the **Pershing III**, using additional third and fourth stages to give intercontinental range. With the same throw-weight as the SICBM, the 13.11-m (43-ft) long, 1.02-m (3.33-ft) diameter missile would have a maximum range of 12875 km (8,000 miles).

The SICBM and Pershing III are also projected as having alternate road-mobile Tractor-Erector-Launcher (TEL) basing. Both Boeing and General Dynamics are investigating the possibilities, the latter firm developing a specially armoured carrier/launcher under the codename 'Armadillo'.

The lightweight ICBM has now evolved into an augmentation system for Peacekeeper rather than a replacement, with an initial operational capability date of 1992. The chosen design for production will be picked in the latter part of the decade and will probably be assigned the popular name Midgetman when it finally comes into service.

The new small ICBM currently under research and development for the US Air Force is shown in this cutaway drawing as it might appear when it enters service in the 1990s. Very likely to be given the popular name Midgetman, the small ICBM will supplement MGM-118 Peacekeeper.



USSR

Tupolev 'Blackjack' strategic bomber

As a successor to the Tupolev Tu-22M (or Tu-26) 'Backfire' the new Tupolev design bureau is developing a variable-geometry strategic bomber codenamed **'Blackjack'** by NATO. In the late 1980s this is due to start replacing first elderly Myasishchev M-4 'Bison' and then the older variants of the Tu-95 'Bear'. The primary role undertaken by the new bomber will be as a stand-off missile platform for the AS-15 cruise missile, using a rotary launcher arrangement in the bomb bay. Secondary roles will include air-defence penetration using gravity weapons and maritime support to the Soviet navy.

A production run of at least 100 aircraft is envisaged at a new complex recently completed at the Kazan airframe plant, with the first squadron expected to attain operational status in 1987. The 'Blackjack' is similar in configuration to the Rockwell B-1, but is much larger and faster. The engine installation comprises two pairs of single-shaft turbofans mounted beneath the rear part of a massive fixed-wing glove that houses the variable-geometry wing systems. With or without inflight-refuelling the 'Blackjack' will have the capability of attacking virtually any target in the world from either the Soviet homeland or bases in friendly nations.

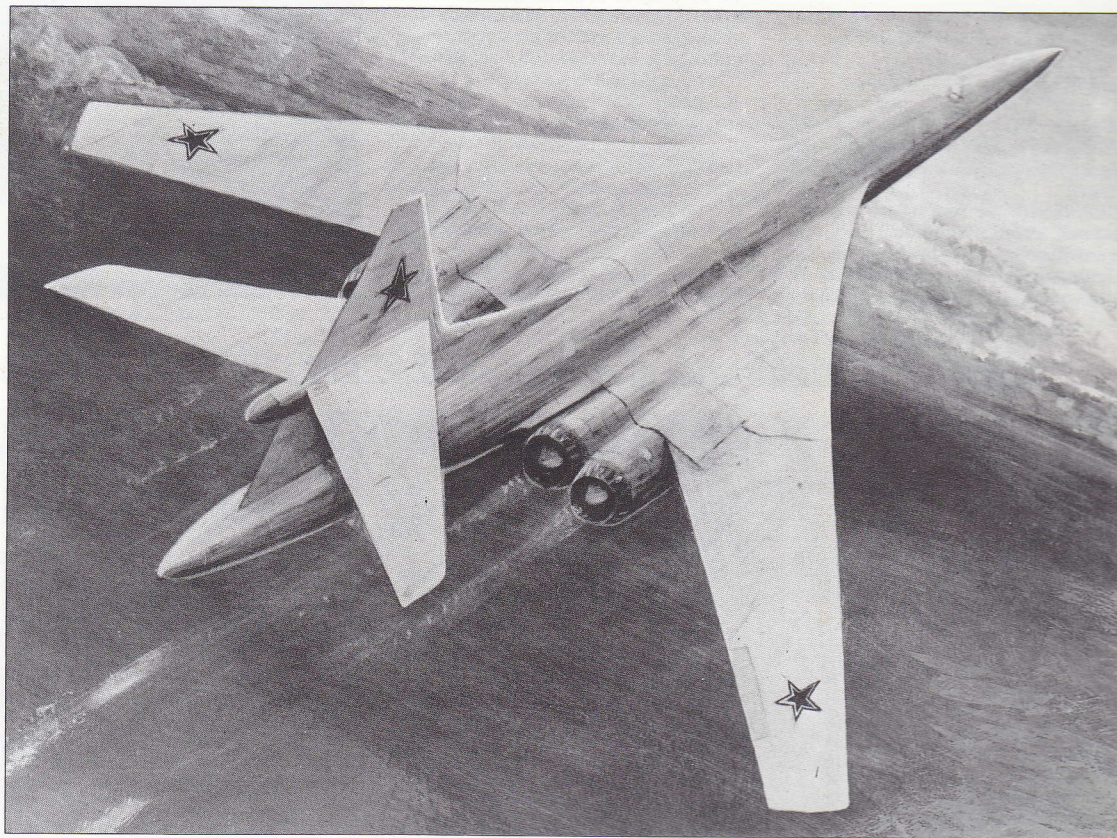
Specification (provisional)

Tupolev 'Blackjack'

Type: multi-seat strategic bomber

Powerplant: four 22000-kg (48,501-lb) thrust class turbofans

Performance: maximum speed 2225 km/h (1,383 mph); maximum combat radius with maximum weapon load and no inflight-refuelling 7300 m



(4,536 miles)
Weight: maximum take-off 310000 kg (683,422 lb)
Dimensions: span, spread 52.0 m (170.6 ft) and swept 33.75 m (110.73 ft);

length 52.0 m (170.6 ft); height 13.75 m (45.11 ft)
Armament: up to 16330 kg (36,000 lb) of missiles and/or bombs

Similar to the Rockwell B-1B in form, although larger and of higher performance, the 'Blackjack' is likely to enter operational service in 1987/8.

AS-15, SS-C-4 and SS-N-21 cruise missiles

The AS-15, SS-C-4 and SS-N-21 cruise missiles are the NATO designations respectively for the airborne, ground and submarine-launched versions of the same basic design. Similar in concept to the American BGM-109 Tomahawk, the turbojet-powered missiles are deployed in the following manners. The AS-15 ALCM is carried as four- or six-round units on underwing pylons of the new-build turboprop Tupolev Tu-95 'Bear-H' strategic bomber. With a range of 2735 km (1,700 miles), the Mach 0.6 missile has a CEP of some 45 m (150 ft) with a 150-kiloton yield warhead. The AS-15 will also become part of the armament of the new Tupolev 'Blackjack' bomber and be retrofitted to some Tu-22M 'Backfire-C' bombers.

The SS-C-4 ground-launched missile is now entering service and is carried in a four-round launcher bin on the back of a MAZ-532 derivative 8x8 wheeled truck chassis. Using the same terrain-following guidance system as the AS-15, the SS-C-4 is believed to have a range slightly increased to about 3050 km (1,895 miles).

The SS-N-21 is the version fired from a standard 533-mm (21-in) torpedo tube, and has been issued to the latest Soviet nuclear attack and cruise missile submarines from the 'Victor III' class onwards in an effort to counter the US Navy's SSNs fitted with land attack nuclear-armed cruise missiles. The range, guidance system and warhead are the same as the other versions, thus considerably complicating defence of both the continental USA and European NATO powers.

Specification

AS-15, SS-C-4 and SS-N-21 series

Dimensions: span 3.45 m (11.32 ft); length 6.9 m (22.64 ft); diameter 0.533 m (21 in)

Weight: 1500 kg (3,309 lb)

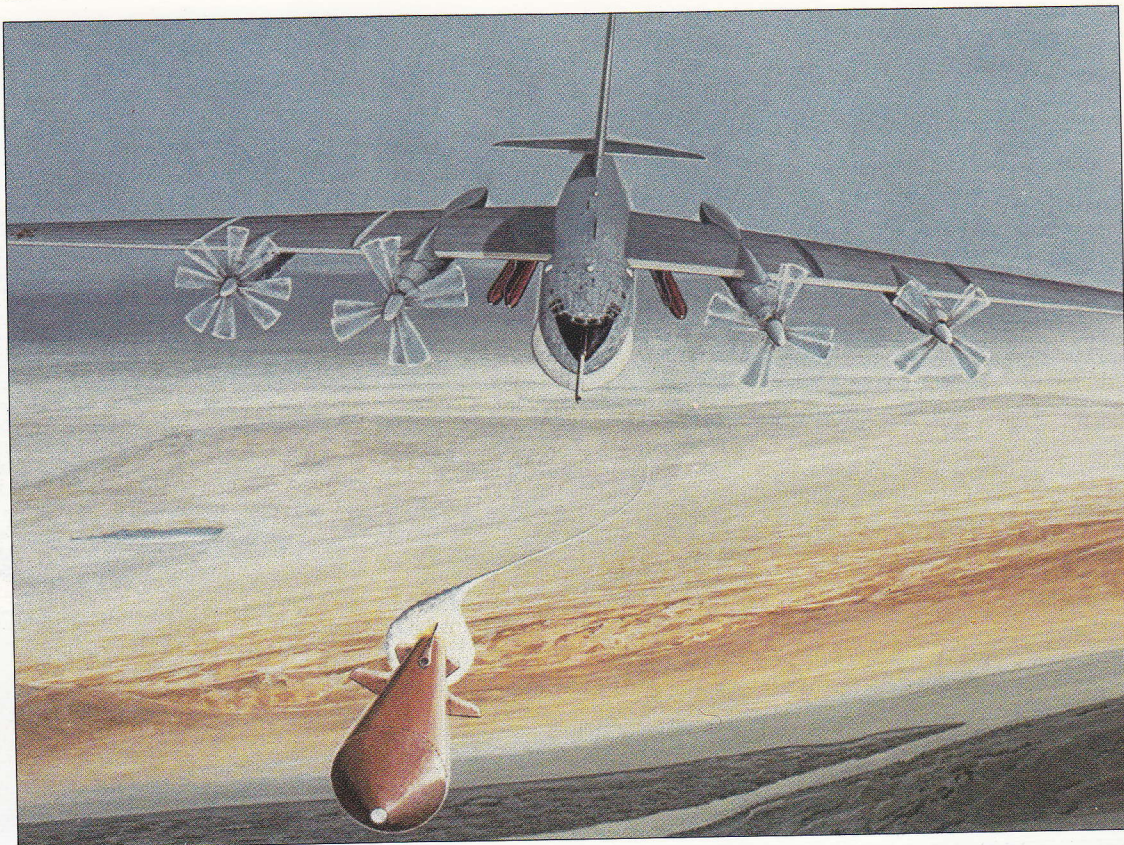
Warhead: 150-kiloton thermonuclear

Range: 2735 to 3060 km (1,700 to 1,900 miles)

CEP: 45 m (50 yards)

Launch: aircraft, wheeled TEL or submarine

Guidance: inertial and terrain-following



Above: A US Department of Defense impression of the new-build Tupolev Tu-95 'Bear-H' launching an AS-15 turbojet-powered cruise missile shows the weapon to be similar in concept to the BGM-109 Tomahawk. It is thought to have a range of up to 3060 km (1900 miles) and a high degree of accuracy.

Right: The single Soviet 'Papa' class cruise missile submarine is thought to have been armed with SS-N-9 anti-ship missiles. The introduction of the SS-N-21 has vastly extended its weapon range, being operated out of standard torpedo tubes.



Soviet tactical and short-range ballistic missile systems

Whilst the Soviets have directed a very skilful propaganda campaign against the Americans for modernizing the NATO theatre intermediate nuclear forces (INF), they have themselves embarked upon a major reorganization of their own INF systems.

The replacement for the FROG-7 (Soviet designation R-75, Luna-M) tactical missile is the NATO-designated SS-21 'Scarab' (Soviet name Tockha, or point) which was initially deployed in 1976 in small numbers. By late 1985 the total had grown to some 250 launchers. The missile is carried within the belly of a derivative of the three-axle 6x6 ZIL-167 vehicle that has already been used for the SA-8 'Gecko' SAM system. The tractor-erector-launcher (TEL) is fully amphibious, and the inertially-guided solid-propellant single-stage missile is moved into the vertical position for launching whilst the vehicle is stabilized by four hydraulic jacks lowered to the ground. The SS-21 can be armed with a nuclear, chemical or

cluster-munition warhead. The SS-21 is also in service with the Syrian (one regiment of 12 launchers), Iraqi (one brigade of 18 launchers) and Czech armies.

The SS-1B/C 'Scud' (Soviet designations R-17 and R-17E respectively) operational/tactical missile replacement is the inertially-guided single-stage SS-23 'Spider', which uses an eight-wheeled MAZ chassis with an environmental protection chamber as the TEL. The missile can be fitted with a nuclear, chemical or cluster-munition warhead. The first SS-23s entered service with the Soviet army in early 1980 and, as a consequence of its new

First seen in public during a Red Square parade in 1985, the SS-21 'Scarab' is a much more capable replacement for the unguided FROG-7 battlefield support missile. It has been exported to Syria, Iraq and Czechoslovakia.



solid-propellant powerplant, has reduced the reaction and refire times of both Soviet army and front missile brigades by perhaps 66 per cent. By late 1985 over 100 TELs were in service with the Soviet army.

The last of the trio of replacement missiles is the operational/tactical inertially-guided two-stage **SS-12M 'Scaleboard'** (formerly the **SS-22**) which entered service in 1979 as a variant of the original SS-12 with reduced reaction time, and improved range and accuracy. By 1984 SS-12M systems had been forward-deployed to Soviet army bases in both East Germany and Czechoslovakia as counters to NATO's INF systems. Each modified MAZ 8x8 SS-12M TEL has a reload round in the front or army's missile brigade supply train. A total of 80 of the original SS-12 launchers had been modified for the new missile by late 1985.

American intelligence sources already report that variants of all three systems with CEPs of less than 30 m (32.8 yards) are under test for possible deployment in the next decade.

Specification

SS-21 'Scarab'

Dimensions: not known

Weight: not known

Warhead: 10- or 100-kiloton nuclear, chemical or cluster munition

Ranges: minimum 14 km (8.7 miles)

and maximum 120 km (74.6 miles)

CEP: 50-100 m (55-110 yards)

Launch: wheeled TEL based on the ZIL-167

Guidance: inertial



Specification

SS-12M 'Scaleboard'

Dimensions: not known

Weight: not known

Warhead: 550-kiloton nuclear, chemical or cluster munition

Ranges: minimum 220 km (138 miles) and maximum 880 km (547 miles)

CEP: 320 m (350 yards)

Launch: wheeled TEL based on the MAZ-537 vehicle

Guidance: inertial

Specification

SS-23 'Spider'

Dimensions: not known

Weight: not known

Warhead: 200-kiloton nuclear, chemical or cluster munition

Ranges: minimum 80 km (50 miles) and maximum 500 km (311 miles)

CEP: 280 m (305 yards)

Launch: wheeled TEL based on the MAZ 8x8 vehicle

Approximate equivalent of the US Army's Pershing 1a, the SS-12 'Scaleboard' is classified as a battlefield support weapon, though with an estimated range of up to 880 km (550 miles) and a thermonuclear warhead of up to 550 kt it can fulfil an almost strategic role. Alternative warloads can include chemical and cluster or dispensing munitions.



USSR

'Delta IV' class SSBN and SS-N-23 SLBM

Production of the 'Delta III' SSBN with its SS-N-18 SLBM at Severodvinsk was stopped in 1984 with the completion of the fourteenth unit. The follow-on class is the **'Delta IV' class**, whose first unit was launched in the February of that year at the same shipyard. With a similar production rate to the 'Delta III' a total of four boats will be afloat by the end of 1986. The only difference between the two classes is that the length of the new variant has been increased slightly and the missile tubes modified to accept the more accurate **SS-N-23 SLBM** that achieved operational capability in 1985. This is a fifth-generation three-stage stellar inertially-guided solid-propellant SLBM with a MIRV warhead package of the type that was first tested on the SS-N-18 Mod 3. The submarine is assessed as being able to operate under the polar ice cap, and can easily break through areas of thin ice to launch its missiles. Retrofitting of the SS-N-23 into 'Delta III' class boats at a later stage is possible. American intelligence sources are already expecting the flight testing of an SS-N-23 replacement later this decade, whilst a test flight for the SS-N-29 carried by the 'Typhoon' class SSBN is imminent.

Specification

Delta IV' class

Type: nuclear-powered ballistic missile submarine

Displacement: 10,100 tons surfaced

and 11,600 tons dived

Dimensions: length 157.5 m (516.7 ft);

beam 12.0 m (39.4 ft); draught 8.7 m

(28.5 ft)

Propulsion: two pressurized water-cooled reactors powering four sets of steam turbines driving two shafts

Speed: 20 kts surfaced and 23.5 kts dived

Dividing depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum

Armament: 16 launch tubes for 16 SS-N-23 SLBMs, and six 533-mm (21-in) bow tubes for a maximum of 12 torpedoes

Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow

sonar, one medium-frequency torpedo fire-control sonar, VHF/SHF/UHF communications systems, one ELF floating communications buoy, one VLF towed communications antenna, one 'Brick Group' ESM system, one 'Pert Spring' satellite communications system, and one 'Cod Eye' navigation system

Complement: 150

Specification (provisional)

SS-N-23

Dimensions: length 13.6 m (44.62 ft);

diameter 2.0 m (6.56 ft)

Weight: not known

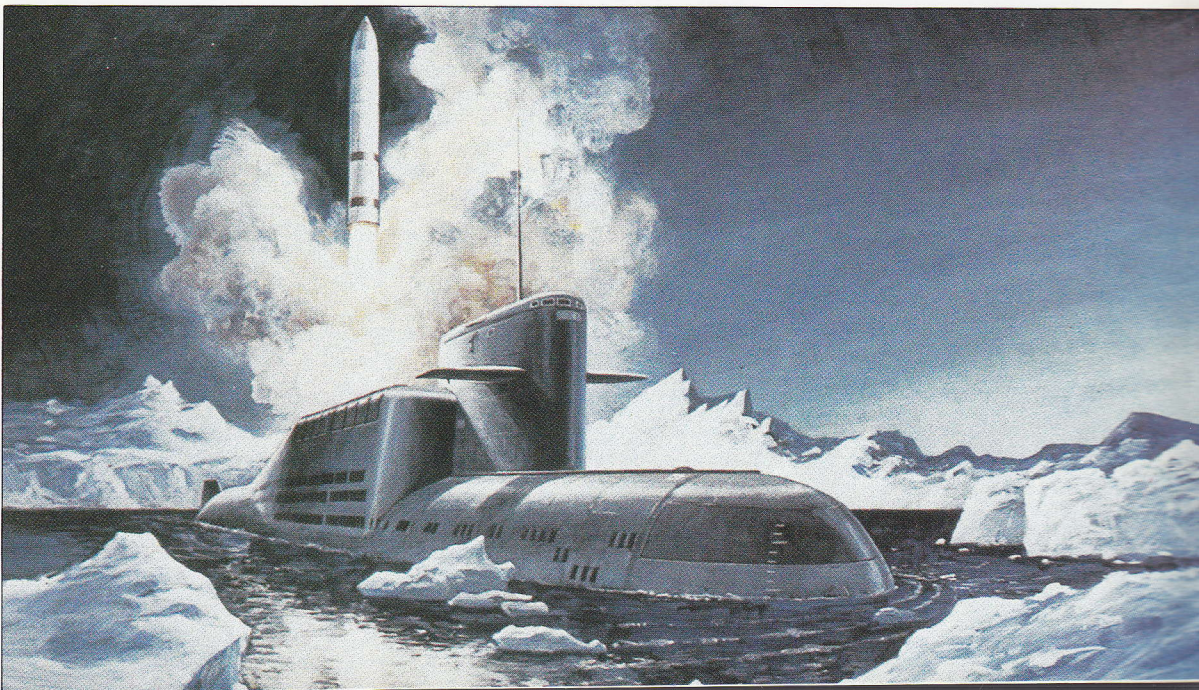
Warhead: seven 150-kiloton MIRVs

Range: 8300 km (5,160 miles)

CEP: 560 m (610 yards)

Guidance: stellar inertial

The launch of an SS-N-23 missile from a 'Delta IV' amid the Arctic pack ice, as visualized by the US Department of Defense. The missile is comparable to the C4 Trident I, although thought to be much less accurate.



Soviet ABM systems

Currently the Soviets operate around Moscow the world's only operational ABM system. Deployed initially in 1968, the system began an upgrading and expansion programme in 1980 to bring it up to the maximum limit of 100 launchers set by the 1972 ABM treaty with the USA. The original single-layer defence system relied on 64 reloadable above-ground launchers for the liquid-propellant three-stage exo-atmospheric ABM-1A/B 'Galosh' (Soviet designation UR-96) missiles in four complexes with six 'Try Add' tracking and guidance radars at each plus two 'Dog House' and 'Cat House' battle-management radars south of the capital to control the engagements and assign targets.

The modified ABM system will be operational by 1989 and comprise modified ABM-1C 'Galosh' interceptor missiles emplaced in hardened silos for exo-atmospheric attacks, and a new SH-04 silo-based high-performance endo-atmospheric missile of similar concept to the US high-acceleration Sprint. A reload capability for both systems has been demonstrated, whilst to control the new weapons the Soviets have built a new large phased-array battle-management radar at Pushkino, north east of Moscow, to serve both the original complexes and the new ones under construction.

Initial launch detection of an American, NATO or Chinese ICBM attack is currently handled by a launch detection satellite network and two over-the-horizon radars which can provide a warning of up to 30 minutes and pinpoint the general origin of the attack. Actual confirmation, determination of its size and composition, and provision of target-tracking data to the relevant ABM battle-management radar is then carried out by six peripheral radar sites equipped with a total of 11 'Hen House' ballistic missile early warning radars. This network is being upgraded by the addition of six new

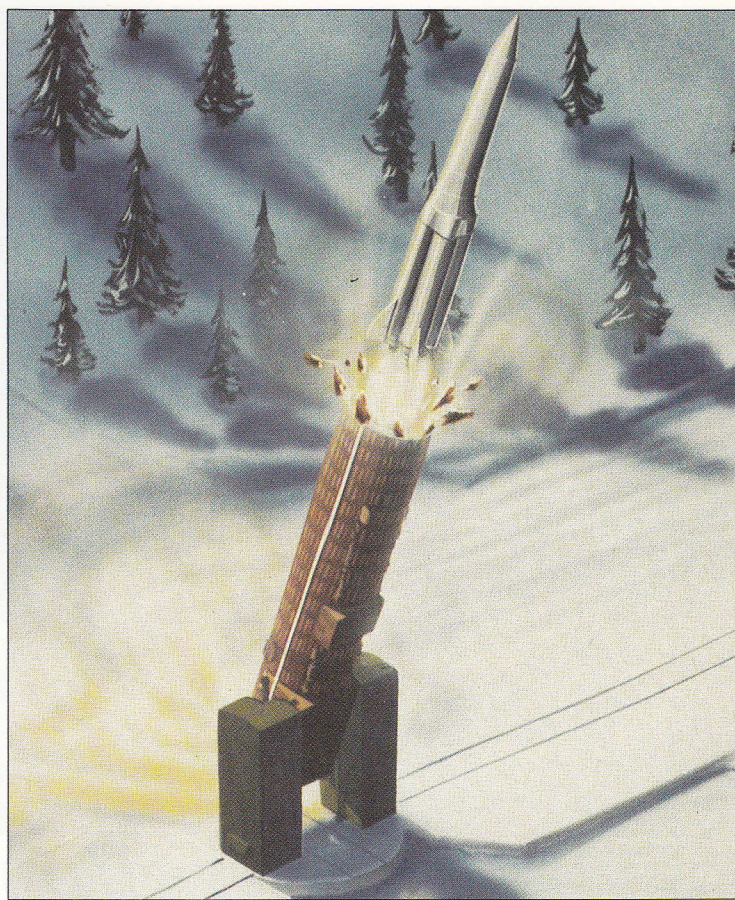
phased-array radars that can track more targets with greater accuracy. Five of the sites duplicate or supplement the coverage of the 'Hen House' whilst the sixth, at Krasnoyarsk in Siberia, closes the only gap in missile EW coverage of the USSR.

It is also apparent that the Soviets are developing a mobile ABM system which could be ready for deployment in the early 1990s at any desired location to provide a countrywide ABM defence network rather than one simply for the capital and its surroundings. The Soviets have also tested SAM air defence radars in ABM related exercises and could use their SA-5 'Gammon', SA-10 'Grumble' and SA-12 'Gladiator' SAMs to intercept some types of strategic missile re-entry vehicles. A massive research programme in using advanced technology such as lasers and particle beam weapons is also under way for possible deployment late in the next decade.

Specification ABM-1B 'Galosh'

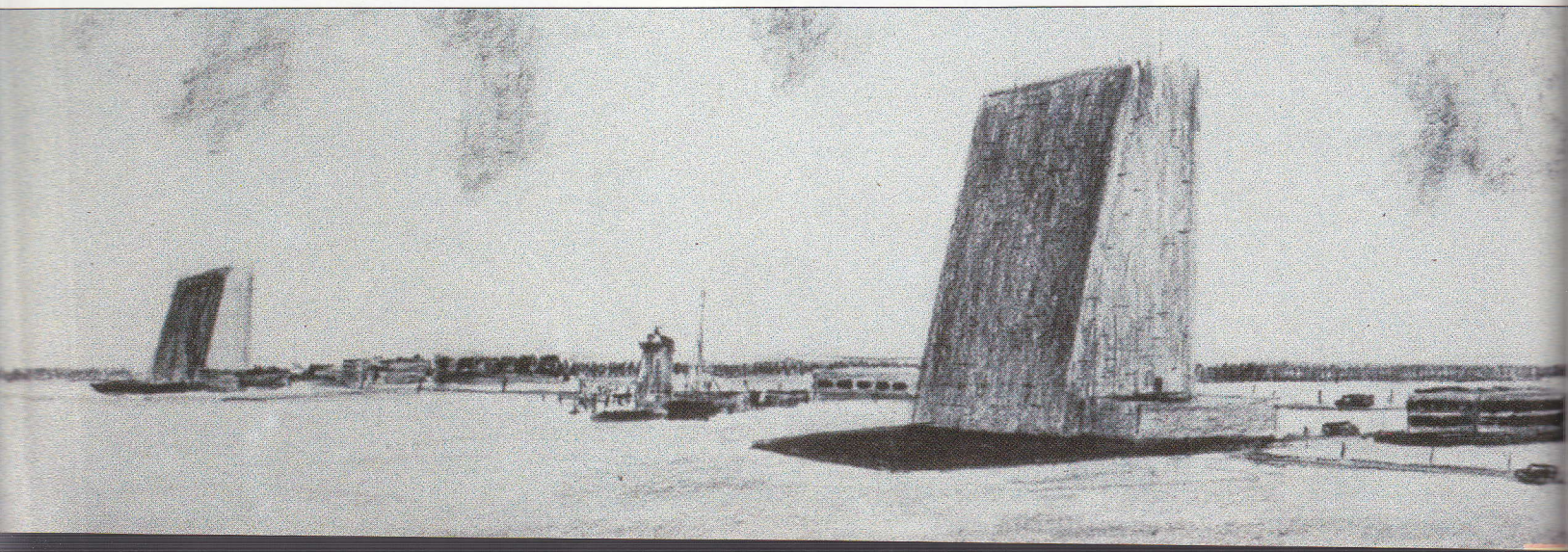
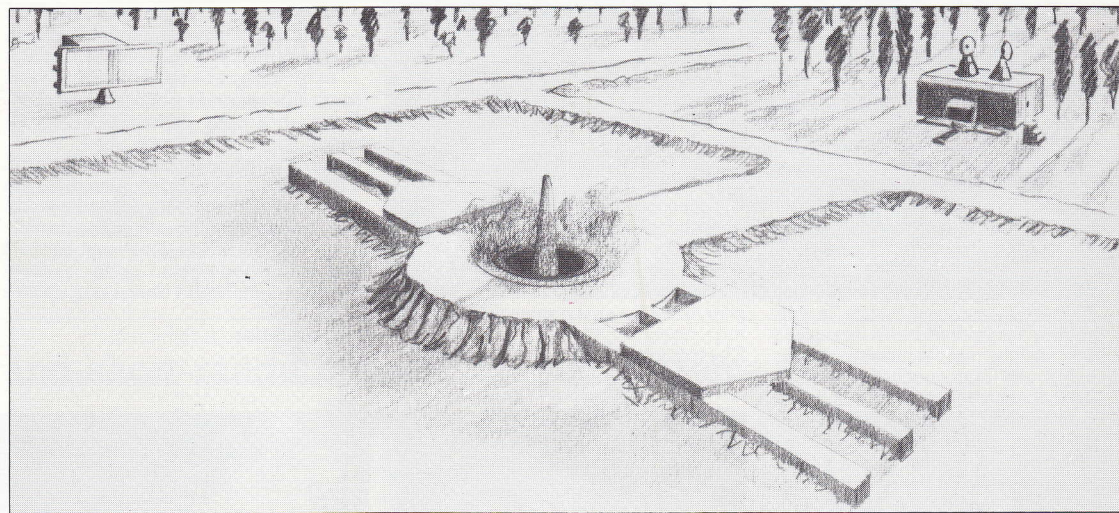
Dimensions: length 19.8 m (64.96 ft); diameter 2.57 m (8.43 ft)
Weight: 32700 kg (72,090 lb)
Warhead: 5-megaton thermonuclear
Range: 740 km (460 miles)
Guidance: radar command

Right: An American impression of the missile at the heart of the world's only operational ABM system, known to NATO as the ABM-1 'Galosh'. It is deployed in 100 launchers around Moscow.



Right: The upgrading of Moscow's ABM defence has seen the emplacement of a new hypersonic missile type, presumably intended for endo-atmospheric interception, in association with upgraded models of the ABM-1. The parallel to the cancelled US Sentinel system is clear.

Below: The phased array radar at Krasnoyarsk is claimed by the USA to violate the 1972 ABM treaty in that it is designed for ballistic missile detection and tracking, and not purely for space tracking.





USSR

SS-24 medium ICBM

Initially deploying into 100 former SS-11 'Sego' silo complexes, the three-stage solid-propellant SS-24 medium ICBM entered operational service in 1985. By 1988 it will also be deployed as a mobile system on 26-m (85.3-ft), 120,000-kg (264,550-lb) class 4x4 heavy-duty rail truck missile-launchers, which will be located in a series of hardened railway tunnels that are being constructed in various areas of the USSR where the standard 1.52-m (5-ft) broad-gauge railway system has no overhead power cables. The tunnels will also house the support railway stock comprising 29.5-m (96.78-ft) TSMVO-66 class launch-control vans and smaller KVZ-TsNII two-axle personnel accommodation trucks. The launcher truck is fitted with electrically-powered hydraulic rams to erect the missile capsule into the launch position, a side-folding roof, a missile-ejector unit, and four hydraulically-operated outriggers to stabilize the vehicle during firing.

The SS-24 was first identified under the Western codename PL-04 (Plesetsk Test Range Missile No. 4), first round being launched in October 1982 but suffering a first-stage failure according to Western intelligence sources. By the tenth flight on 6 September 1983 six further failures had occurred, although the problems had apparently been solved by the time of its deployment. The maximum throw-weight of the missile is assessed at 3600 kg (7,937 lb) for its MIRV payload.



Specification (provisional)

SS-24

Dimensions: length 21.25 m (69.72 ft); diameter 2.0 m (6.56 ft)

Weight: 100,000 kg (220,459 lb)

Warhead: 10 350-kiloton MIRVs

Range: 10,000 km (6,215 miles)

CEP: 200 m (220 yards)

Launch: silo or mobile railway-based type with a cold-launch system for rapid reload facility

Guidance: stellar inertial

The fifth generation SS-24 ICBM, while replacing SS-11 'Sego' missiles in silos, is expected to be mobile on special trains by the end of the 1980s. Flight tests have been completed at the Plesetsk test facility, and deployment of the system has begun.



USSR

SS-25 lightweight ICBM

Formerly known by the designation PL-05, this V.N. Nadradezh-designed solid-propellant lightweight ICBM entered operational service in 1986 as the SS-25. Said by the Soviets to be a modification of the SS-13 'Savage', the SS-25 began to replace these missiles in their 60 silos at the Yoshtar Osa missile field as the initial deployment. Up to 200 additional silo-launched SS-25s are to be deployed at former SS-11 'Sego' sites with either a single 550-kiloton yield RV or three/four 150-kiloton yield MIRVs as the payload. In the mobile version a total of 20 sites (each for 10 off-road launchers based on the MAZ-548/7910 heavy-duty wheeled truck chassis) are being prepared at SS-20 IRBM fields. Intended to replace additional SS-22 launchers, the sites consist of a number of buildings with sliding roofs, concrete hard stands and enclosed vehicle parking facilities for support vehicles. The launch vehicles can either fire from within their own buildings or, if time permits, deploy to presurveyed sites many miles away. A reload capability is available, and individual missile throw-weight is assessed at up to 1,000 kg (2,205 lb). Flight testing of the SS-25 began during 1982, with one test on 30 May 1983 involving the maximum four-MIRV payload.

Specification (provisional)

SS-25

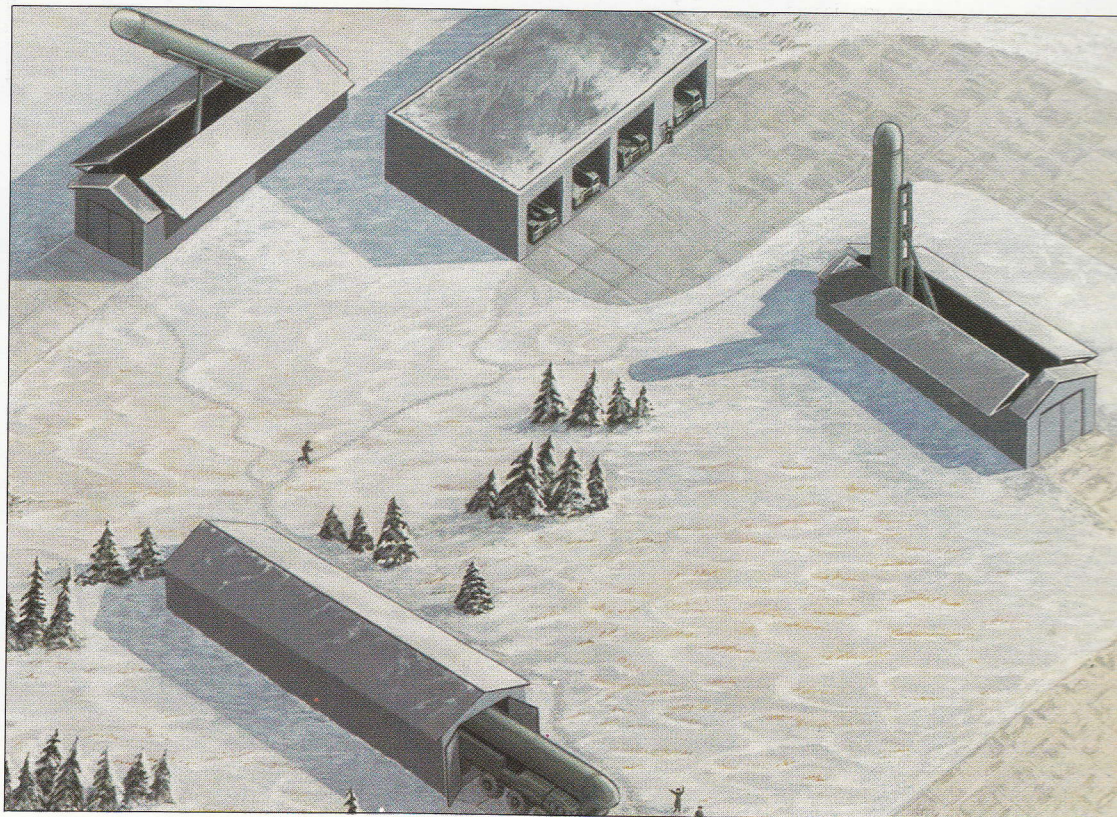
Dimensions: length 19.0 m (62.34 ft); diameter 1.7 m (5.58 ft)

Weight: 37,000 kg (81,570 lb)

Warhead: three or four 150-kiloton MIRVs or one 550-kiloton RV

Range: 9,000 km (5,590 miles)

CEP: 200 m (220 yards)



Launch: hardened silo or wheeled TEL type with cold-launch system for rapid reload facility

Guidance: stellar inertial

Approximately the size of the US Minuteman, the SS-25 could be an improved version of the first Soviet solid propellant ICBM, the SS-13. Unlike the US missile, however, the SS-25 seems to have been intended from the outset for mobile deployment, and two mobile bases have been built.

Chinese IRBM, MRBM and ICBM update

Since the survey of Chinese strategic missiles in a previous issue of *War Machine*, a considerable amount of fresh information has become available to clarify the situation. All development of these systems is the responsibility of a design bureau located at the Shuang-Chengzi missile test centre in the Gobi desert.

The first missile produced was the **Dong Feng 1 (DF-1, or East Wind-1)** SRBM, a locally designed variant of the Soviet SS-2 'Sibler', which was itself an updated German V-2 development. Armed with a conventional HE warhead, the missile was 16-m (52.49-ft) long and 1.65-m (5.41-ft) in diameter, and the single-stage 20500-kg (45,194-lb) missile was pushed to a range of between 560 and 740 km (348 and 460 miles) by a liquid-propellant rocket. The type was deployed in limited numbers during the 1960s and early 1970s, its life being extended into the late 1970s by the retrofitting of the nuclear warhead of the DF-2.

The **DF-2** (Western designation **T-1** or **CSS-1**) MRBM was the first major missile to be produced in China, the type's development starting in 1959-60 on the basis of technology derived from the Soviet SS-3 'Shyster' MRBM. The DF-2 was initially deployed in the north eastern and north western areas of China during 1966. Some 100 rounds were produced between 1966 and 1969, although only 50 or so concrete pad-type launch sites were actually used. It is believed that the DF-2 is now being phased out because of its obsolescence. The DF-2 was the subject of a full-scale test in 1966 using an

armed nuclear warhead.

The third missile deployed was the **DF-3 (T-2 or CSS-2)** IRBM, which was developed at the beginning of the 1960s using technology derived from the Soviet SS-5 'Skean' but actually following the DF-2 onto the production line from 1970 to late 1974. Operationally deployed in 1972, it is also fired from a fixed site and some 70 are currently believed to be in service. Modified DF-3s were used in April 1970 and March 1971 to launch China's first two satellites.

The first Chinese ICBM, the limited-range **DF-4 (T-3 or CSS-3)** entered the development phase in 1967. The first rounds were produced in 1973 but deployment did not start until 1975. Believed to be a two-stage variant of the DF-3, the DF-4 was slow to build, construction of some 25 rounds taking until 1983. The weapon has recently been the subject of a major product improvement programme to upgrade its electronics, to enhance its range and targeting capabilities, and to fit what may be China's first attempt at a MRV or MIRV warhead system. The DF-4 is also the basis of the three-stage **Changzheng-1 (CZ-1 or Long March-1, Western designation CSL-1)** satellite booster rocket, which was used to put several satellites into orbits up to 265 km (165.7 mile) high during the mid-1970s. Only 10 DF-4s are in service with II Artillery Corps, based in 13.8-bar (300-lb/sq in) hardened concrete silos.

The next ICBM began development in 1973 as the two-stage largely experimental **DF-5 (T-4 or CSS-4)** with

four liquid-propellant rocket motors powering the first stage and one motor the second. Initially tested in 1980, the DF-5 also formed the basis of the two-stage **CZ-2 (CSL-2)** and three-stage **CZ-3 (CSL-3)** boosters that are capable of launching close-orbit and geosynchronous satellites respectively. The former has been used to launch China's first photo-reconnaissance satellites. Although rivalled in size by only the Soviet SS-18 series, the CSL-3 has a maximum throw-weight of only a meagre 2000 kg (4,405 lb), which is a reflection of China's relatively inefficient propellant industry. The operational version of the DF-5 is thought to be the slightly modified **DF-6 (T-5 or CSS-5)** to give a longer range. Deployed in central China in five underground missile silos, the DF-6 represents the current state of the art in Chinese strategic missile production.

Specification

DF-2

Dimensions: length 22.8 m (74.8 ft); diameter 1.6 m (5.25 ft)
Weight: 26000 kg (57,319 lb)
Warhead: 15-kiloton fission or conventional HE
Range: 1200 km (746 miles)
CEP: 2780 m (3,040 yards)
Launch: pad with hot-launch system
Guidance: radio command and inertial

Specification

DF-3

Dimensions: length 20.6 m (67.59 ft); diameter 2.46 m (8.07 ft)
Weight: 27000 kg (59,524 lb)
Warhead: 200-kiloton thermonuclear

Range: 13200 km (1,988 miles)
CEP: 1390 m (1,520 yards)
Launch: pad with hot-launch system
Guidance: radio command and inertial

Specification

DF-4

Dimensions: length 26.8 m (87.93 ft); diameter 2.46 m (8.07 ft)
Weight: 50000 kg (110,229 lb)
Warhead: (initial version) 3-megaton thermonuclear or (later version) three/four 200-kiloton MRVs or MIRVs
Range: (initial version) 5000 km (3,107 miles) or (later version) 6960 km (4,325 miles) for later version
CEP: 1930 m (1,015 yards)
Launch: silo with hot-launch system
Guidance: (initial version) radio command and inertial or (later version) inertial

Specification

DF-5 and DF-6

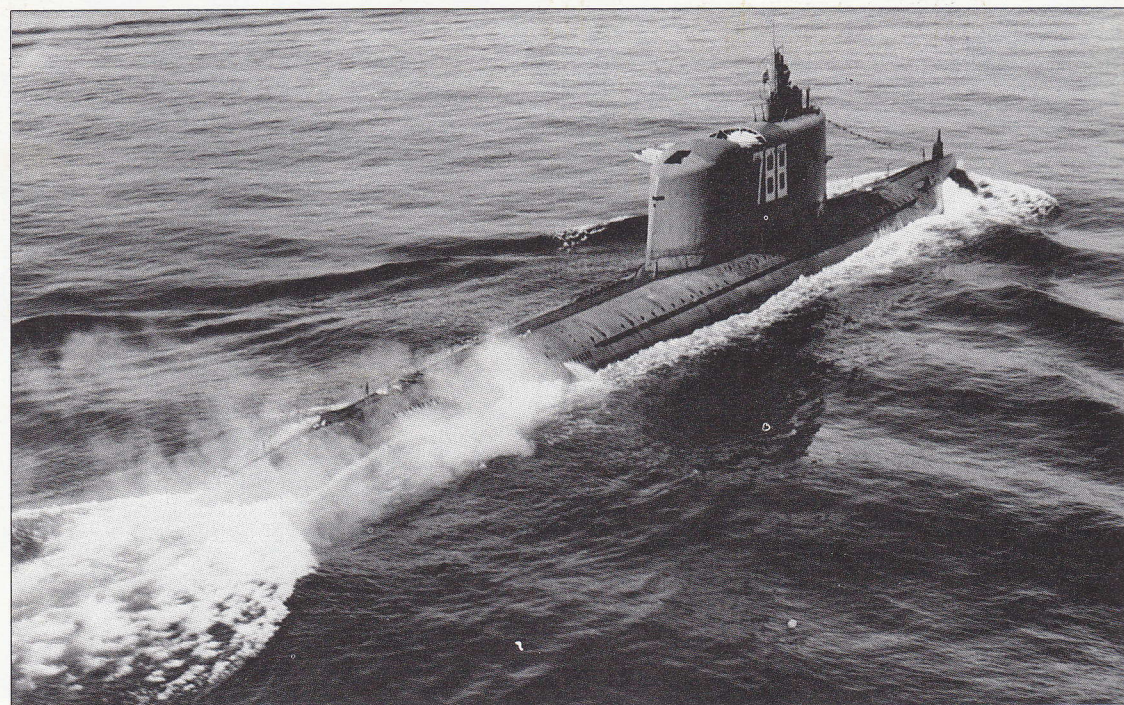
Dimensions: length 32.5 m (106.63 ft); diameter 3.35 m (10.99 ft)
Weight: 20000 kg (44,017 lb)
Warhead: (DF-5) 4-megaton thermonuclear or (DF-6) 5-megaton thermonuclear
Range: (DF-5) 10000 km (6,214 miles) or (DF-6) 13000 km (8,078 miles)
CEP: 1930 m (1,015 yards)
Launch: silo with hot-launch system
Guidance: inertial

Chinese SLBM programme

Design of an indigenous SLBM began in China during the late 1960s by a design team located at the Shuang-Chengzi missile test centre. The two-stage solid-propellant missile which resulted was given the Western designation **CSS-N-2**, and was initially tested aboard the sole locally-assembled but Soviet-designed Type 200 'Golf' class conventionally-powered SSB. Fitted with two 10.6-m (34.78-ft) by 2.4-m (7.87-ft) missile tubes, the 'Golf' boat undertook its first trial launch in the early 1980s. Although at least one of the Type 07 'Han' class SSNs was also modified during construction to carry six CSS-N-2 tubes, a number of problems were encountered during the missile's protracted development, which resulted in only a limited production run being undertaken between 1975 and 1984.

Many of the faults were corrected in the following two-stage solid-propellant **CSS-N-3**, which was first test fired in October 1982 from its carrying platform, the 12-tube Type 09 'Xia' class SSBN, two or three of which are now in service. These are to be supplemented in the late 1980s by the first of six Type 09 'Xia (Mod)' class SSBNs, which are fitted with 14 tubes for the definitive two-stage solid-propellant **CSS-N-4**, which is due to become the standard SLBM for new-construction SSBNs until the mid-1990s, when a MRV-equipped variant is expected to enter service.

Specification CSS-N-2



Dimensions: length 10.0 m (32.81 ft); diameter 1.5 m (4.92 ft)
Weight: 14000 kg (30,864 lb)
Warhead: 1-megaton thermonuclear
Range: 2700 km (1,678 miles)
CEP: 2800 m (3,060 yards)
Guidance: inertial

Specification CSS-N-4

Dimensions: length 12.8 m (41.99 ft); diameter 2.3 m (7.55 ft)
Weight: 20000 kg (44,092 lb)
Warhead: 1-megaton thermonuclear
Range: 3200 km (1,988 miles)

Built from designs supplied by the USSR, the 'Golf' class ballistic missile submarine has been the basis of Chinese SLBM development.

CEP: 1850 m (2,025 yards)
Guidance: inertial